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NOTES AND COMMENTS.

Mathematical Biology.

IN one of his delightful "Imaginary Portraits," Mr. Walter Pater gives a rendering of the mediæval legend of the return of the golden age, as a pagan Renaissance caused by the actual return among men of a denizen of ancient Greece. There came, under the influence of the reborn pagan, a period strangely in dissonance with the times before and after. "One man engaged with another in talk in the market-place; a new influence came forth at the contact. Another and then another adhered. At last a new spirit was abroad everywhere. The hot nights were noisy with swarming troops of dishevelled women and youths with red-stained limbs and faces, carrying their lighted torches over the vine-clad hills, or rushing down the streets, to the horror of timid watchers, towards the cool spaces by the river. A shrill music, a laughter at all things, was everywhere."

It is not the kind of pagan to cause these occurrences who has been born among us. But the prevailing application of physical reasoning to Biology, so often referred to in Natural Science, might be pictured under the idea that someone who, with Democritus, had sat at the feet of Leucippus, had been working in the German laboratories and had been indoctrinating Oxford and Cambridge and London. Professor Weismann's germ-plasm in its later elaborate form is a notable instance of the new tendency. In it the whole organism is formed of units of different grades. The unit of each higher grade is a multiple of the unit of the grade next lower. The multiples of each unit are built up in some physical scheme of architectonics. Bütschli refers the structure of protoplasm and its physical properties to questions of density and surface tension. In many parts of his argument one must have a text-book of physics open to understand him. A large part of the current work upon variation is expressed in mathematical terms, while the study of growth almost necessarily involves mathematical reasoning.

In Dr. Haacke's "Gestaltung und Vererbung," a notice of which appears in another part of our columns, almost a burlesque of this tendency to mathematical reasoning appears. Again and again consecutive pages are filled with formulæ that stretch over three lines of serried signs and figures and brackets, while his new theory of heredity and development depends upon geometrical conceptions.

These physical views are to be traced chiefly in the work of morphologists, and more than once contributors to our columns have contrasted, in this respect, morphological work with the tendency towards vitalism of the physiological school of the present time. But the contrast is more apparent than real. The "vitalists" are studying the phenomena of life as things-in-themselves, as being kindred to, but not compounded of, chemical and physical phenomena. The result of physical reasoning applied by morphologists as yet has been to give a fuller idea of the individual and homogeneous nature of living matter all through the animal and plant kingdoms, rather than to explain the nature of living matter on physical principles. The new method tends not to make biology a branch of geometry, but to introduce a new science of biometry.

ANOTHER CRITIC OF WEISMANN AND ANOTHER THEORY.

IN addition to Dr. Haacke's book, we have before us two pamphlets published at Hamburg in 1894, but originally delivered as addresses, by Dr. George Pfeffer, to the Naturwissenschaftlicher Verein. The title of the first, rendered into English, is "The Intrinsic Errors of Weismann's Germ-Plasm Theory." It objects to the theory chiefly on the ground that it implies the conception that Natural Selection works in the same method as would be employed by a creator working with a definite object in view. It is certainly the case that many organisms have structures or properties by which they are saved from destruction or gain an advantage in the struggle for existence. Dr. Pfeffer thinks, and, it is true, many critics of Weismann agree, that Weismann's view of evolution implies an illogical extension of the above statement into the statement that these adaptations, protective or aggressive, have been called into existence by Natural Selection because of their utility; that, in fact, Natural Selection, on Weismann's showing, is a teleological cause. Of course, Weismann himself has expended much pains in attempting to convince, and has succeeded in convincing many, that his theory implies no such illogicality. We do not think that Dr. Pfeffer has brought forth anything that will increase the faith of the opponents of Weismann or unsettle that of his supporters. The title of the other pamphlet is more difficult to render into English. As near as may be it is "The Transformation of Species—a Process of Self-Development." It is based on addresses delivered in March, 1893, and in January, 1894. Like Dr. Haacke, he makes much of the "blessed word" equilibrium. The whole organic world is in equilibrium; a

change of the conditions anywhere throws the whole system out of gear, and when it settles again into a new position of equilibrium, everything will be slightly altered, some things much altered. Similarly, the body of every organism is in equilibrium and changes of any part are reflected over every part. The method of change favoured by Dr. Pfeffer is change of function. Changes of species, he says, occur by reason of the change of function of the species in question.

The difficulty about these, and many similar pamphlets in English and in German, is that they contain much shrewd criticism and ingenious suggestion, coupled with a complete failure to understand the difficulties of the general questions they lightly solve in a magazine article or an after-dinner speech. What we want is not general theories, but particular facts. We want to be shown in the laboratory or in the field how far and in what way changes of function, and so forth, do occur; how the changes affect, and to what extent they affect other parts of the organism; and, above all, how far and in what way these changes are inherited by the offspring of the animals or plants in question. It is the fashion to abuse Professor Weismann's views as theoretical and divorced from experiment and observation, but that is only a fashion of the ignorant. If his conclusions come to nothing, there will be left behind a large and valuable body of contributions to anatomy, embryology, and natural history. Without this side of his work, it is certain that the theory known as Weismannism would have received neither the vast body of praise nor of abuse that have been its meed.

The Normal Nature of Ammonite Abnormalities.

If Weismannism has done nothing else, it has served to instil fresh life into the study of abnormalities and variations of all kinds. This study is beset with many difficulties, and not the least of them is the absence of a standard of comparison. In the investigation of normal forms the observations of one investigator can be confirmed and corrected by those of others. In the case of abnormalities there is much more room for the error arising from personal equation, but where independent investigations lead authors to similar conclusions, it speaks well for the results. Curiously enough, this is to a certain extent the case in reference to a paper which appeared in our last number, "Can the Sexes in Ammonites be Distinguished?", by Messrs. Buckman and Bather (p. 427). After that had gone to press a paper "Ueber Ammonoiden mit 'anormaler' Wohnkammer," was received from Dr. J. F. Pompeckj.[1] It deals with Ammonites which are said to show "abnormal body-chambers," that is to say, body-chambers which in breadth or thickness are less than they should be if the previous rate of increase of the shell had been maintained.

[1] Jahreshefte Vereins Naturkunde Württ. 1894. Pp. 220–290, pl. iv.

The opinion of Munier Chalmas that this so-called abnormality was a sexual character was commented on adversely by Messrs. Buckman and Bather, who regarded it as one of the characters of old age, and we now note that Dr. Pompeckj comes to a similar conclusion. His paper also deals with the question of resorption or absorption of the body-chamber in course of growth. This idea was put forward to explain the occurrence at the same localities of very different-sized Ammonites of presumably the same species, the smaller with "abnormal" body-chambers, and the larger (the presumed adults of the smaller) with normal coiling at the diameter of the smaller. Dr. Pompeckj, however, rejects such absorption as a principle of Ammonite growth, and explains this concurrence of forms by Dr. Walther's doctrine of dispersal after death (NAT. SCI., iv., p. 245), intimating that all such specimens, whether big or little, are full grown. But there are other difficulties in connection with this, which Dr. Pompeckj's hypothesis does not seem to meet; and his conclusion (p. 289) that "an Ammonite with abnormal body-chambers is, almost without exception, to be considered as full grown," may not be readily accepted. Other opinions of Dr Pompeckj's will no doubt be challenged, and exception might be taken to the application of the term "abnormal" to that which is a normal process of growth in racial or individual decline, and which even when carried to excess, as in *Macroscaphites*, scarcely deserves to be called an abnormality. All the same, the work is a notable addition to Ammonite literature.

AUTOTOMY IN ECHINODERMS.

THE obscure processes of budding and regeneration are at least as interesting as the nature of variations. It is a well-known text-book fact that Echinoderms have considerable power of recuperating external injuries, to such an extent, indeed, that a single arm torn off a starfish is said to reproduce the whole animal. It is also generally believed, and in some cases known to be true, that these animals can of their own accord break off or eject portions of their body, which may, in a few instances, form new individuals. We wish to direct attention to two observations, which, though not very recent, seem, owing to the places of their publication, not to have attracted the attention they deserve.

In the fifth volume of the *Proceedings of the Liverpool Biological Society* (p. 81), Mr. H. C. Chadwick describes how he placed three individuals of the holothurian, *Cucumaria planci*, in a jar, and how a strange thing happened to each of them. The middle portion of the body was pulled out and became very thin, till at last the animals broke in two. Then the front halves crawled away, "leaving their tails behind them" motionless. Each front half developed a new anus, and each hinder part developed a new mouth and circlet of tentacles. Then one of the animals derived from a hinder part divided again,

so that before two months were up Mr. Chadwick had seven sea-cucumbers instead of three.

In the twenty-first volume of the Norwegian North-Atlantic Expedition, Dr. D. C. Danielssen tells us that among the specimens of *Bathycrinus carpenteri* dredged, a large number were found to have thrown off the part of the crown that lay above the basals, and in several instances to have reproduced it again. He further points out that, while the other specimens dredged had genital products developed in their pinnules according to the normal method of sexual reproduction, the crowns that were thus thrown off were sterile; and he suggests that, when the sexual powers of the old crown are worn out, it is rejected, and a new one with fresh powers grown in its place. Now, if we remember that the most recent investigators concur in deriving the genital rachis of the crinoid arm from an extension of the so-called "dorsal organ," which lies between the basals, then we see that this recuperation of the crown may be regarded as a means of obtaining a fresh extension of this dorsal organ into that part of the crinoid where alone its generative faculty is available for sexual purposes—namely, into the pinnules. This idea certainly countenances Dr. Danielssen's suggestion. At the same time, we must not forget that in certain ophiurids, as Lütken and Cuenot have observed, reproduction by fission only occurs in immature individuals, and sexual reproduction appears to ensue only when this asexual method has been many times repeated. On the other hand, it is interesting to observe that, out of Mr. Chadwick's three holothurians, two discharged a quantity of ova before fission set in. Another interesting fact may be gathered from Dr. Danielssen's account, to wit, that the stages of growth of the new crown are similar to the ordinary stages of growth in the young crinoid: the arms long remain closed, and the anus is formed at a late period. Until the alimentary canal resumes its functions, whence does the rapidly-growing animal obtain its nutriment? What can be its reserve store? Is it indebted to the dorsal organ, and is this regeneration more closely allied to development *ab ovo* than we think; or does the animal live on the blood contained in the cavities of the stem?

Few observations have yet been made on the relations of spontaneous fission to sexual reproduction in the Echinoderms, and the subject seems to afford a fertile field for investigation, not without its bearing on the deeper problems of the time.

The Depths of the Sea.

Increased knowledge of the depths of the sea will no doubt help us to a solution of problems like those we were discussing in the foregoing paragraph; but, notwithstanding the numerous exploring voyages of the past 20 years, we have still much to learn about this part of our globe.

Dr. Otto Pettersson has just published, in the *Scottish Geographical*

Magazine for June, an important paper on Swedish Hydrographic Research in the Baltic and the North Seas. Dr. Pettersson commences by stating that "the system adopted by the Swedish naturalists at the present time, in their explorations of the sea which surrounds the Scandinavian peninsula, is to despatch a number of ships simultaneously from different ports across that part of the sea which is to be explored, each ship being provided with a complete set of hydrographic instruments, worked by assistants specially trained for their task in the laboratories of Stockholm's Högskola, the Polytechnic Institute, etc. The route of each ship, and the position of every sounding station, are determined beforehand, according to previous experience. In every successive expedition the same sounding-places are chosen, in order to ascertain the alterations which have occurred in the arrangement of the water-strata. The advantages of this method of research are obvious. All the observations being taken within a few days, the hydrographic state of a certain part of the sea at all points is exhibited practically simultaneously, unaffected by changes of wind and weather." Surveys of the Baltic have been undertaken in 1877, 1878, and 1879, but the more systematic surveys of which this paper treats were taken between 1890 and 1893.

After treating in detail, and with illustrations, of the special apparatus used, Pettersson gives specimens of the results obtained as regards temperature at various depths in the Gullmar Fjord, the deepest depression of the Baltic (S.S.E. from Landsort), and the deepest part of the Aaland Sea. In the Gullmar Fjord temperature ranged steadily downward from 17·50 C. to 4·60 C. (60 metres), then rose again gradually to 5·04 C. (120 metres, bottom). In the Landsort series the temperature marked 13·06 C. at the surface, 2·15 C. (60 metres), rose again gradually to 4 C. at 280 metres, to sink again to 3·95 C. at bottom (400 metres). In the Aaland Sea 8·05 C. was registered at the surface, 1·80 at 30 metres, 2·95 from 40–70 metres, and then a steady fall to 1·65 at 265 metres (bottom). Full instructions are given for the method of obtaining analyses of gases dissolved, and the determination of the total carbonic acid contained in sea-water, as well as chlorine titrations, specific gravity, and salinity. A description is then given of Pettersson's Plankton apparatus, the results obtained with which showed that water-layers of different origin and different depths contained different and characteristic forms of animal life. For instance, on 2nd August, 1893, the biologists accompanying the expedition distinguished three strata of water in the Gullmar Fjord, which showed marked differences with regard to temperature and salinity, and marked differences in the fauna. The detailed results are given in the pages, but space precludes our inserting them here. Dr. Aurivillius is now engaged on an investigation of the animals obtained, and we await his results with interest. The final paragraph of this interesting paper is

as follows:—"The Plankton obtained in November was very different from that which we found at the same place and depths six months before. Suffice it to say, that in quantity the winter Plankton was far in excess of that of the summer; that the vegetable matter seems to predominate in the colder season; and that abundance of living organisms were brought up from a depth of 70 metres in November, while no Plankton was found at the same depths in August. In the middle of the Skagerack the character of the Plankton at 30 and 40 metres is different from that at 10 metres, a fact which could be predicted from the hydrographic conditions of the central part of the Skagerack."

The "Quarterly Review."

The Swedish explorations of the ocean floor lead us naturally to the ocean surface. The current number of the *Quarterly Review* has an intelligent article entitled "Ocean Meadows," in which is given an interesting popular account of surface flora and fauna. The account is based largely upon the revision of those wide-spread algæ, the heterocystic Nostocaceæ, by MM. Ed. Bornet and Ch. Flahault, and on Maurice Gomont's monographs on the Oscillaria. The writer points out the many problems of pelagic life still waiting solution—problems that have not only a scientific but a great economic interest. For without question the "unvintagable sea" is one of the greatest food sources of the land. The fisheries of the world are capable of almost indefinite extension: but this extension can proceed only when we have sufficient knowledge of the feeding and breeding of food-fish to allow us to take full benefit of this supply of food without disturbing breeding grounds or driving fish to remote inaccessible haunts. The writer urges that further work be done. "No costly equipment is needed. The use of a cruiser (of dignified speed only) would, no doubt, be furnished by the Admiralty for a brief period, while the Government grant administered by the Royal Society is often spent with less return than an investigation of this kind, costing a small portion of its annual amount, would yield. Let the fitting men come forward and demand it."

Whether or no the precise method recommended by the "Quarterly Reviewer" be the most excellent, we rejoice to see a claim long advocated in scientific journals so ably enforced by a journal of which none can say that it is prejudiced by too strong a predilection for things scientific. The writer of the *Quarterly Review* article might have strengthened his case by reference to two elaborate monographs dealing with oceanic matters, and both recently noticed in Natural Science. The results published by Dr. Brooks in his Monograph on Salpa (*see* Natural Science, vol. iii., pp. 222–225, and vol. iv., pp. 457–462) bear in many important ways upon economic problems. Dr. Brooks was aided by his Government, for

the material was collected by the United States Fish Commission. The beautiful monograph by Mr. Savile Kent on the Great Barrier Reef (*see* NATURAL SCIENCE, vol. ii., pp. 453–460) is of at least equal economic importance, and serves the better to point the present moral, in that the expense of the exploration and of the publication of the volume was largely borne by the Government of Queensland.

Another article in the same issue of the *Quarterly* is of greater length and equal scientific interest. It makes a demand, not upon the pockets of the ratepayers, but on the fortitude with which they shall see the breaking of an old idol. It has been one of the most popular of our beliefs that Shakespeare was as faithful a depicter of birds and beasts as he was of human nature. But the generation of critics who have palmed upon us this belief have themselves been no naturalists. In this article the "natural history" of Shakespeare is shown to consist almost entirely of literary conventions. In the majority of cases, instead of observing for himself, he has been content to borrow uncritically from his predecessors.

THE JUNGLE BOOK.

ANOTHER writer, who, if he be not read two hundred years after this as much as Shakespeare is read to-day, yet is read more to-day than was Shakespeare by his contemporaries, has written much of animals. But, in addition to the fact that discussing the "Nature writing" of our greatest English writer leads us to the "Nature writing" of our own days, we make no apology for directing the attention of all naturalists who have still that good fortune before them to Mr. Rudyard Kipling's new book. It is an old and not unfounded reproach that too close a scrutiny of the mechanism of the organic world tends to destroy for anatomists the romance of the living world. For them too often Nature becomes an explicable or partially explicable mechanism and an animal a bundle of tissues to be dissected, or the mere seat of functions to be explored and measured. A great novelist once said that the best novels were Nature seen through a temperament. Here is a book about animals seen through a temperament, very different from that generally in association with biological investigation. It is written in the spirit of primitive races, to whom the beasts and the birds of the field and the forest are a people, with their own language and customs, for whom the woods and the plains are full of the mysterious glamour of life. The book tells of the battles and the alliances of animals, of the noon-day heat of the plains, and the stealthy bustle of the night. Keen observation and the artistic method employed by Mr. Kipling in his stories of man do not fail him in these stories of animals, nor is there wanting evidence of that peculiar turn of mind by which Mr. Kipling sees in the canons of army life the supreme standard of moral excellence. But criticism, as the author himself would say, "is another story." Of the tales in the "Jungle Book," two in especial

delighted us. In an earlier volume, under the title "In the Rukh," Mr. Kipling described how an Englishman, serving under the Commissioners of Woods and Forests in India, found an ideal native ranger. This was the foster-brother of wolves who, having grown up among the beasts of the jungle, had learned all their secrets and had been sworn into alliance with them. Here is the story of his up-bringing: of how he was taught by Baloo, the bear, and Bagheera, the black leopard, and of how he fought and conquered Shere Khan, the man-eating tiger.

The other story that attracted us is laid in very different surroundings. It tells of the lives of seals, of their breeding-places, and of their molestation by man.

In this volume, where animals are personified and made to tell their own stories, it is of no value to trace out the exact degree to which zoological accuracy has been carried. In the main the characters of the animals are displayed so that they need not disturb the equanimity of the most sensitive taxonomist. The general reader will get a picture of the chief animals dealt with, such as all the details of the taxonomist would never give him.

The Education of Sally.

Mr. Rudyard Kipling has written several stories of monkeys, but we doubt if he has studied them so carefully as the late Professor Romanes, who successfully conducted the education of the chimpanzee at the Zoological Society's Gardens. Although a full account of this was published in the *Proceedings* (1889, p. 316) of the Society, our readers may find it interesting to have the matter recalled. Sally's education was carried on under considerable difficulties, as the constant presence of visitors distracted her attention, and required an unusual amount of patience in her teacher. She was first taught to associate actual numbers with the names for them. This was done by asking her repeatedly for one straw, two straws, or three straws; these she was to pick up and hand out from among the litter in her cage. When she handed a number not asked for her offer was refused. When she obeyed correctly she was rewarded by a piece of fruit. Lastly, if two straws or three straws were demanded, she was taught to hold one straw or two straws in her mouth until she had picked up the remaining straw, and then to hand the two or the three straws together. This prevented her from being correct in her action merely by the interpretation of vocal tones.

Before long she learned exactly what was meant by the sounds of the first three numbers, and then with similar success her education was extended up to six. Beyond six she was inaccurate, but she never failed to realise that seven, eight, nine, or ten meant a number of straws greater than the lower numbers.

Professor Romanes believed that the result of these experiments

did not imply that in "counting" the ape employed any system of notation. "We know," said he, "from our own experience, that there is counting and counting, *i.e.*, distinguishing between low numbers by directly appreciating the difference between two quantities of sensuous perc eption, and distinguishing between numbers of any amount by markin g each perception with a separate sign." In the case of some persons, he went on to say, the former method of perception could reach so far as the number twenty. It was this method that he imagined the ape to exhibit, and as the perceptions of such an animal are naturally less proficient than those of man, it was natural that above six or seven vagueness should begin, while, at least, it was perceived definitely the number was greater than those correctly interpreted.

Professor Romanes went on to attempt to make Sally associate colours with their names, but although Sally could distinguish between white and coloured straws, she could not be taught to distinguish between any of the colours. Hence he came to the remarkable conclusion that Sally was colour-blind, although of course he had no means of deciding whether her colour-blindness were only an individual defect.

The Bird's Foot.

In Mr. Finn's interesting paper on the bird's foot, published in our last number (Natural Science, vol. iv., p. 453), the writer assumes, and most ornithologists would agree, that the typical number of digits in the bird's foot is four. In support of this he refers to Forbes's discovery of the rudiment of a hallux in three-toed birds like the albatross. But he did not mention an important piece of evidence discovered, or at least noted, by Garrod, and pointing in the same direction. The chief muscle of the hallux is a flexing muscle named the *flexor longus hallucis*. In all cases where the hallux is absent, this muscle still persists with a well-developed fleshy belly and a separate tendon, the latter uniting with the deep flexor tendon of the other toes. This, certainly, is strong evidence, were more evidence wanted in favour of three-toed birds being derived from a four-toed stock. But viewed merely as a rudimentary organ, it is not so interesting as at first appears; for in the great majority of birds, and in all near allies of three-toed birds, the tendon of the flexor of the great toe is connected by a tendinous slip with the common deep tendon of the other toes. So it must be inferred that the *flexor longus hallucis* of three-toed birds remains, not as a mere rudiment, but because it is functional, as an accessory to the flexor of the other toes. A three-toed passerine bird would be interesting, because in passerines there is no connection between the flexor of the great toe and the common flexor of the other toes. But there is no three-toed passerine.

The Colours of Birds' Eggs.

The value to be assigned to the colour of eggs in classification, is a point in which the personal equation plays an enormous part. Probably no two ornithologists would agree about many of the most common cases. Some of the difficulty, no doubt, is due to our ignorance of the natural processes by which the colours and markings are produced. Dr. Heinrich Wickmann has recently published, at Münster, a pamphlet of sixty-four pages on the origin of the colouring of birds' eggs. He states that the egg-shells of most birds consist of three parts. There is the inner elastic and fibrous layer, with which we are all familiar, and which is double, the middle calcified layer, and a thin organic cuticle, which is not found in all eggs. In coloured eggs the ground colour is to be distinguished from flecks of colour. These latter extend only a very small distance into the calcified layer, while the ground colour penetrates to the innermost part of the shell. But white eggs, says this author, are not unpigmented and white merely because chalk is white. There are separate white pigments present, and an egg of which the white ground colour is due to one pigment may be flecked with white spots of another white pigment.

He agrees with Kutter that the colours are deposited while the egg is in the uterus, before it has reached the cloaca, and gives a list of birds, including the duck, the heron, partridge, crow, falcon, blackcap, cuckoo, nightingale, and snipe, in which he has found actually in the uterus an egg with the complete normal colouring. Further, he rejects all former hypotheses as to the place of origin of the colours, and comes to the conclusion, although on what seems to us insufficient evidence, that all pigments are formed in the ovary shortly after the egg has entered the tube, and are discharged into the tube, down which they follow the egg to the uterus. He believes that the origin of the colouring matters is to be found in the blood, which undergoes katabolic changes during the formation of the *corpus luteum*. The different colours of the eggs, even of nearly-allied birds, he explains in a somewhat cavalier manner, by attributing them to slight differences in the chemical constituents of the blood of these animals. We do not think that Dr. Wickmann has left nothing for future investigators, and we regret that he has given insufficient details of his methods of investigation; but he has made a notable contribution to oölogy. In a concluding paragraph, the writer says, with some pride, that all the work was done in his private room, and that he has to thank no professor nor institution for aid.

Tadpoles.

The day has gone by for accepting Tadpoles, or indeed any larval forms, as simple survivals of an ancestral condition. We know now that the larvæ of many sponges echinoderms, marine

worms, and above all of many insects, are so modified in connection with their own conditions of life, that only in the broadest way can they be said to be more primitive than the adult forms to which they give rise. They are more primitive chiefly in that they are simpler animals, animals with less complexity of structure, and thus animals which have a broad similarity to the less complicated more ancient form of life. In the case of the larvæ of those animals which are now called *Chordata* because, though they may never attain to the possession of a bony backbone, they possess the gelatinous notochord which is accepted as the predecessor of the backbone, there is strong reason to believe that the simple structure of the free-swimming stage is misleading. The Tadpoles of Ascidians and Amphibia, for instance, possess many simple characters which we believe that the original ancestors of all the Vertebrata possessed. But this simplicity is most probably a case of convergence. Tadpoles live in water. They capture their food, escape from enemies, move about, live and breathe much in the same way and in the same surroundings as the simple pelagic ancestors of the Vertebrata. And thus in many ways they resemble these ancestors. But they are not now taken, at least by most zoologists, to be actual surviving ancestral stages.

The curious Tadpoles of the African Frog, *Xenopus lævis* (*Dactylethra capensis*), may be taken as a favourable instance of this change of view. Among the striking peculiarities of these Tadpoles are a development of pigment so slight that the nerves and blood vessels can be seen through the transparent skin; a pair of long whip-like tentacles protruding in front from the angles of the mouth, and a fish-like appearance, due to the absence of any constriction between the broad head and the body. These points, and some others, were taken to imply that the Tadpoles of *Xenopus* represented in a peculiarly intimate fashion some fish-like ancestor of the frogs. This resemblance was exaggerated in some figures published by the late W. K. Parker in an otherwise most valuable account of this Tadpole. The figures were copied in many text-books, and the fish-like appearance was still more exaggerated, some innocent markings on the back of the animal being so drawn as to resemble the dorsal plates of some extinct armoured fish.

Mr. F. E. Beddard, F.R.S., recently had an opportunity of re-investigating these forms, and the results of his work appear in the last issue of the Zoological Society's *Proceedings* (1894, p. 100). He shows how some of the mistaken impressions have arisen, and describes how, in most respects, the Tadpoles of *Xenopus* are not markedly different from the Tadpoles of the common Frog. In the first two days of their life they possess, just like the frog, a suctorial gland below the mouth, and the head is separated from the body by a constriction. After the third day these disappear, and the peculiarities of the more advanced form come into existence. The details of structure mentioned are too technical to repeat here, but the

general conclusion of Mr. Beddard's investigation is that there is no more reason to consider the Tadpoles of *Xenopus* fish-like and ancestral than in the case of any other Tadpoles.

The Botany of Tropical Africa.

The recently issued number (ser. 2., vol. iv., part 1) of the Linnean Society's *Transactions* (Botany) contains an account of the plants of Mt. Milanji, Nyasaland, collected by Mr. Alexander Whyte. At the instigation of Mr. H. H. Johnston, our Commissioner and Consul-General in British Central Africa, Mr. Whyte, towards the end of the year 1891, explored the Natural History of this mountain and district, and his collection of plants has been worked out by the officers of the botanical department of the British Museum. The region is about twenty miles to the south of Lake Shirwa, and sixty miles W.S.W of Blantyre. It comprises an isolated range of, for the greater part, precipitous mountains, many of the gullies and ravines being well wooded, while favoured nooks of the highlands are bright with gorgeous displays of flowers. Including those now described for the first time, no less than 62 per cent. of the species collected by Mr. Whyte belong to tropical vegetation. Six per cent. of the remainder are plants with a wide distribution in the tropical and subtropical regions of the world. Thirteen per cent. are North African plants, chiefly Abyssinian, while nineteen per cent. are South African. Milanji is, in fact, in the region where the floras of North and South Africa meet and intermingle with the characteristic tropical vegetation. Several Malagasy plants are also found. Of special interest are two species of *Erica*, which carry the South African heaths into the tropics, and a new conifer, of which the nearest allies are also found at the Cape. The plant in question, *Widdringtonia Whytei*, is described as a magnificent tree, reaching a height of 140 feet, sometimes with a clear straight stem for 90 feet, and a diameter of 5½ feet at six feet from the base, sometimes giving off long, straggling branches nearer the base. The timber is of a pale reddish colour, of excellent quality, and easily worked. Unfortunately, these fine trees are rapidly disappearing before the forest fires, the few left being confined to the upper ravines and valleys, a large forest finding a comparatively secure habitat in the damp gorges of the Lutshenya valley. It is pointed out that its nearest ally, *W. juniperoides*, of the Cederberg Mts., Cape Colony, seems also to be dying out, as it is now rare, though it once formed great forests. We are glad to learn that steps have been taken for the preservation of the Milanji forests, and that seedling plants are being raised with the prospect of affording increased supplies of this useful timber in the future.

Apropos of trees, the great hall at the Natural History Museum now boasts the largest section this side the Atlantic. In one of the bays on the right-hand side will be found a horizontal slice from one of the Californian mammoth trees (*Sequoia gigantea*). It measures

15 feet across, and its age, when cut down in 1892, has been computed, by counting the annual rings, at 1335 years, which means that it sprang from the seed in 557 A.D. It is somewhat appalling to think of the ages required for the action of Natural Selection in forms where the life of the individual is prolonged to such an extent.

THE MUSEUMS' ASSOCIATION.

THE Museums' Association may be said, in fashionable phrase, to have arrived, when so eminent an authority as Hofrath Dr. A. B. Meyer, Director of the Royal Zoological and Anthropologico-Ethnographical Museum at Dresden, dedicates to it a handsome quarto, with twenty plates, descriptive of the various improvements in Museum fittings that he has introduced into his own Museum. This volume, which is, by the way, the first number of a new publication, the "Abhandlungen und Berichte," of the above Museum, describes in detail and gives working plans of wall-cases, table-cases, skeleton-stands, large spirit-tanks for exhibition purposes, cases of drawers, cases and trays for eggs, nests and shells, a craniometer and a craniophore, trucks and trollies and other minor aids to Museum exhibition. In the construction of cases, trays, and drawers, Dr. Meyer's chief peculiarity lies in the exclusive use of glass and iron, which render the cases fireproof and, he contends, absolutely proof against dust. A description of some of these cases has already been given by him in the Report of the Museums' Association for 1891, and we hope that some member of that body will lose no time in publishing an English rendering of this very suggestive and practical paper.

The Museums' Association is, at this our time of publication, meeting in Dublin, and the address of the President, with which, through the courtesy of Dr. Ball, we are in this number able to present our readers, deals with the history of the Dublin Museums. Meanwhile, there has just been published in the *Proceedings of the Liverpool Naturalists' Field Club* a very similar address by their President, Mr. G. H. Morton, which relates the story of the Museums of Liverpool. The present Museum, which has reached a very high stage of development, through the exertions of the late Rev. H. H. Higgins and Mr. T. J. Moore, was preceded by quite a different Museum, belonging to the Royal Institution of Liverpool. Under the care of William Swainson, T. Stewart Traill, Henry Johnson, Francis Archer, and other well-known naturalists, the collections of this Museum assumed considerable importance, and included a large number of valuable type-specimens. "It was," says Mr. Morton, "very useful to students of natural history, and a source of instruction to the general public. For many years 30,000 persons visited it annually on the free days." But with the rise of the present Free Public Museum, and after the death of the curator, Henry Johnson, a sad state of things ensued. "Neither the proprietors nor the committee cared anything about the Museum, and it perished from

neglect. In 1877 the Mammals, Reptiles, Crustacea, Polyzoa, and Actinozoa were sold to the Corporation of Nottingham, and soon after the Birds, Mollusca, Fossils, and Minerals to the Corporation of Bootle. The Museum contained thousands of interesting specimens collected by members of families still well-known in the city, and they were presented in the hope that they would be preserved—and many were well worth preserving—but the labels and all particulars have been lost and nothing is remembered about them." Mr. Morton does not draw any moral, but it is plain enough. First, co-operation and not competition is wanted in the scientific world; neither men nor money are enough to support more than a very limited number of scientific institutions, even in one of the richest cities of the world. Secondly, if proprietors and committees are unable to recognise the public and national, or rather international, nature of their trust in the preservation of scientific specimens, then the nation should have power to take their trust from them. The sale of these valuable collections may have been within the limits of the law, but it was none the less an iniquity and morally unjustifiable.

Sunday Opening of Museums.

Before leaving the Museums' Association, we cordially recommend its members to read Mr. Holman Hunt's recent address to the Sunday Society. Dr. Ball himself gives evidence that the Museum Curator, overworked though he be, welcomes the opening of his Museum on Sunday. Otherwise he must feel that his labour is largely wasted, since so many of those for whom it is intended have no chance of seeing it. In provincial Museums, too, where so much of the curator's work must be done in the public galleries, Sunday, the curator's holiday, is pre-eminently the day for the admission of "the great public." Such curators will read with pleasure the following extracts from Mr. Hunt's eloquent address:—

"To Christians afraid of scientific pursuit, and who looked upon art as far from deserving of confidence, he would say a word to dissipate their fears. Museums, it was true, presented startling facts to the eyes of men who, like the Mohammedan conqueror of Egypt, ordered the burning of the Alexandrian library with the verdict that all wisdom necessary for the true believer was in the Koran. Now, independent investigation into the bottomless pit of knowledge must by all scientific students be impartial, and must stop at that point where materialistic facts failed to afford further evidence. They, therefore, gave no intentional corroboration of spiritual ideas. He believed that every full-minded person who went to a Museum, and made himself acquainted with the evidences existing there of the links in the order of creation, and of their relation to earlier and later facts, had instinctively increased in him the certainty of the Author's existence, and of His grandeur and of His all-sufficiency to bring about justice and mercy. One most important lesson taught in all Museums, whether the example looked at be a work of nature or of art, was in the demand it had made for long-continued patience. Every fossil spoke of its adaptability to its conditions when in life, as having been produced

by the exercise of steady overcoming of difficulty, and it marked a gradual step towards higher perfection; and so every work of art—and in this class they might include mechanical contrivance—declared as traceably the patient control of the Maker's energies. . . . The exquisite work of all ages, which all might see in Museums, was the surest spur to ambition, and this in its full force made all pains and patience well spent in the accomplishment of good work, and made the artist of every kind turn with disdain from encouragements to mediocrity, which were certainly among the dangers of our day."

DARWIN AND THE Y.M.C.A.

DURING the recent assembly of Christian young men in London, the Rev. James Hastings, M.A., of Kineff, N.B., was reported by the *Daily Chronicle* to have made the following remarks:—

"This is the age of specialists and dwarfs. Darwin is the best example, and I refer to him just because his case is so well and widely known. You remember his confession: that he had spent himself so long and so exclusively upon insects, that the avenues of the soul into which God and music were wont to enter had become closed for ever. This seems to be Darwin's contribution to the knowledge of the world, that responsible men may lose their organs if they refuse to use them."

We do not think of accusing the Rev. James Hastings, M.A., of Kineff, N.B., of bearing false witness, for it is plain that that good man has never troubled to look into Darwin's writings for himself; but it is interesting to notice the evolution of this myth, now "so well and widely known." It was founded upon a few lines in the autobiographical part of Darwin's "Life and Letters." The complete passage is too long to quote; anyone may find it in the first volume of the "Life and Letters," pp. 100–102. Darwin says that he lost the taste for music and poetry and pictures which he had up to about the age of thirty, but that novels remained a wonderful relief and pleasure to him, especially if they had a happy ending. He suggests that his mind had become a "machine for grinding general laws out of a large collection of facts," and that this may have caused an atrophy of that part of the brain alone upon which the higher tastes depend. Of course, there was no word about the soul or God, and as for music, one may read a few pages further on that he never had any ear for music, and that although, like many other people with a similarly defective ear, he enjoyed hearing many tunes, he was never able to recognise an old favourite.

It was that astute ecclesiastic, the late Canon Aubrey Moore, who first laid hold of this passage for controversial purposes. He himself knew well, and did much to combat the view, that Darwinism and infidelity were interchangeable terms, but apparently he could not resist the temptation of suggesting that poor Darwin was devoid of a faculty that the Canon and other ecclesiastics possessed. It was left for later and narrower-minded persons to work up the idea into its present form.

I.

Some Shell-boring Algæ.

A NOTE in the February number of NATURAL SCIENCE (1), to the effect that botanists seemed inclined to keep to themselves information on the subject of shell-boring algæ, suggested that it might be of interest to readers if some account of the results of the investigation of these plants by MM. Bornet et Flahault (2) were forthcoming. The gradual disappearance of the empty shells of bivalves and other molluscs has, until recently, been regarded as the result of their disintegration by the friction produced by the movements of the sea-water, and by the slowly dissolving action of the sea-water, charged with carbonic acid. No doubt this explanation holds good in part, especially for localities where the sea is "wild." In quiet, more or less land-locked bays, another, and to the naturalist much more interesting, cause is now known to contribute to the disappearance of the empty molluscan shells. During the last fifty years many naturalists have made known the presence of tubes of various kinds, branching, and penetrating in different directions, into the substance of fossil and recent corals, fish-scales, and molluscan shells. The late Professor M. Duncan (3) gives, in "On some Thallophytes parasitic within recent Madreporaria," a summary of earlier investigations of the subject, and adds considerably to it himself. Unfortunately, the botanical aspect of the question is by all ignored or misunderstood, the tubes are considered to be parasites living on the organic matrix of the shell or coral, and are of interest chiefly as illustrations of the persistence, through long ages, from the Silurian to the present time, of identical or almost identical lowly organisms. Thus the boring tubes are ascribed to "*Saprolegnia* or *Achlya*, a confervan, a fungus with green coloring matter, if indeed, *Saprolegnia* can be considered a fungus." Two species, *Achlya penetrans* and *Achlya* (*Saprolegnia*) *ferax*, Ktz., are recognised by Duncan, but with this reservation:—"The classificatory position of the parasite is in the midst of a group of forms which have complicated life-cycles, such as the Achlyans (proper), the Saprolegniæ, the Empusinæ and Botritidæ, and the filamentous false-root bearing genera *Codium* and *Bryopsis*—forms which are more or less the expression of one organism under different conditions and age." Professor Duncan's investigations were mainly concerned with corals, of which

he examined many recent specimens, from the littoral zone to a depth of 1,095 fathoms, from waters, with a temperature ranging from 39·7° F. to 55° F., from Davis Straits southwards. His general conclusions were that the boring tubes are more abundant in a coral, the warmer the sea-water and the less the pressure to which it is subjected, and that "the fossil corals of Silurian age were also affected by closely allied, if not specifically identical, forms." It remained for the Swedish botanist Lagerheim (4), in 1886, and more especially for the French algologists Bornet and Flahault (2), in 1889, to supply an accurate botanical account of the perforating organisms, and to point out their most important biological significance—that of shell destroyers.

In a paper by Bornet and Flahault, entitled "Sur les algues perforantes," ten genera are described and their life-histories in some cases more or less fully made known. Of these ten, five are new to science, and are confined, so far as is known, to the peculiar habitat furnished by molluscan shells. All the perforating plants agree in their general mode of development. At first they spread out horizontally in the epidermal layer of the shell, forming an irregular network or radiating round a central point. From the horizontal layer branches grow out, some at right angles, penetrating into the substance of the shell, dissolving its calcareous matter as they proceed. Other branches elongate themselves, parallel to the primary filaments. As time proceeds, these horizontal filaments become so numerous and their branches so close together, that the intervening calcareous matter of the shell finally disappears, and the plant, now in immediate contact with the surrounding water, is able to send off its reproductive cells. The surface of the shell becomes at the same time rough and irregular. It is to Bornet and Flahault we owe the important generalisation that this constant gnawing away of the shell ends in its complete destruction, and is the chief cause of the disappearance of shells in quiet bays where they are not mechanically destroyed by the ceaseless activity of the waves.

The boring plants belong mostly to the blue-green algæ (Cyanophyceæ), and the green algæ (Chlorophyceæ); one is a red alga, two are fungi, and the brown algæ are unrepresented.

The presence of a perforating green plant in a shell is easily distinguished from a mere superficial green deposit of germinating *Ulva*, etc., by scraping with one's nail, or, better, by breaking the shell in two. If the broken surface shows greenness to any depth, one may be satisfied it is due to a perforating alga. The identification of the particular species present requires, in most cases, decalcification of the shell and microscopic examination subsequently. A good deal of information can often be obtained by examination of the shell untreated, under the quarter-inch objective, or by rough powdering of the shell in a mortar. Many of the fragments thus produced stand on edge when placed on a slide, and can be examined as shell sections.

The examination of the living plant is, as the French algologists state, extremely troublesome and fragmentary. The most satisfactory method of examination is by decalcification of the shell with Perenyi's fluid.[1] This solution slowly dissolves the calcareous matter of the shell, and fixes the protoplasm of the boring plant, without destroying its colour. The three commonest and most readily recognised plants are *Gomontia polyrhiza*, *Hyella cæspitosa*, and *Mastigocoleus testarum*. *Gomontia* produces distinct green patches, which, seen with a pocket lens, appear as numerous branching green filaments radiating from a common centre. At certain times dark green specks, the organs of reproduction or sporangia, are observable on the filaments. These sporangia, recognisable readily enough, when young, as part of *Gomontia*, acquire such peculiar characters ultimately, that there is every justification for the mistake made by Lagerheim, who discovered them, of describing them as independent plants of the genus *Codiolum*. *Hyella* and *Mastigocoleus* are often found together, and also intermixed with *Gomontia*. When found pure, *Hyella* is distinguished from *Mastigocoleus* by its patches, which are smaller, more numerous, closer together, later confluent into a network which may give the shell a mottled appearance "like a Fritillaria petal." Both genera give patches of the same colour, grey, blue-black, or violet (Payne's grey); but in *Hyella* one cannot make out with a pocket lens such fine radiating filaments as compose the patches in *Mastigocoleus*. The red alga, *Conchocelis rosea*, Batt., was not known until 1892, when Batters (5) obtained it in 6—8 fathoms off the Cumbrae Islands, in the shells of *Mya truncata* and *Solen vagina*. *Conchocelis* is recognisable to the naked eye as a pink stain penetrating into the substance of the shell. Many of the genera, and the two fungi especially, give no external indication to the naked eye of their presence in the shell, and are only recognisable after decalcification and subsequent microscopic examination.

It would be out of place here to enter into a consideration of the numerous interesting botanical questions discussed by Bornet and Flahault. It must suffice to give an adapted form of their table of genera, and the characters by which they are most easily recognised.

A. Coloured Plants:—

1. Rhodophyceæ (Red algæ)
   Bangiaceæ?

Filaments branched, septate, chromatophores pink and star-shaped, spores (?) single.—*Conchocelis*.

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[1] Perenyi's fluid: Nitric acid, 10 per cent., 4 vol.
Alcohol, 3 vol.
Chromic acid, 0·5 per cent., 3 vol.

This reagent has long been known to zoologists. I used it through their suggestion in the Plymouth Laboratory in 1889, on calcareous algæ.

A. COLOURED PLANTS—*continued*.

2. Chlorophyceæ (Green algæ).
   i. Filaments segmented.
      α. Filaments monosiphonous, conferva-like.
         a. Joints often irregular; branches separated at the base by a wall.—*Gomontia*.
         b. Joints regular, cylindrical; branches without basal wall.—*Siphonocladus*.
      β. Filaments anastomosing, producing parenchymatous expansions.—*Zygomitus*.
   ii. Filaments unsegmented.—*Ostreobium*.
3. Phycochromaceæ or Cyanophyceæ (Blue-green algæ).
   a. Nostocaceæ.
      i. Filaments very much branched, provided with hairs and lateral heterocysts.—*Mastigocoleus*.
      ii. Filaments simple or little branched; without heterocysts and hairs.
         α. Filaments very fine, 0·95 to 1·5 *μ* thick, branched.—*Plectonema*.
         β. Filaments simple, 4-6 *μ* thick, a fresh-water plant.—*Phormidium*.
   b. Chamæsiphonaceæ.
      Trichomes composed of distinct cells, contents of which finally divide into secondary cells. Plant very refractive.—*Hyella*.

B. PLANTS COLOURLESS, appearing to belong to the *Fungi*.
   1. Filaments very fine, straight, uniform, unsegmented.—*Ostracoblabe*.
   2. Filaments irregular, presenting globular swellings.—*Lithopythium*.

Perforating Thallophytes (algæ and fungi) have been found in foraminifera, corals (recent and fossil), calcareous pebbles, fish-scales, and molluscan shells (empty and living), and may yet be found in calcareous rocks. They are to be found from the littoral zone to a depth of 1,095 fathoms, from the Arctic regions to the Equator, and 14° S., and at Cape Horn. They occur in sea- and in fresh-water. Some genera are extremely rare, having been seen on one occasion only. Others are very common. Thus, on the northern shore of Dublin Bay I should have no great difficulty in obtaining a thousand specimens of the razor-shell and others attacked by *Gomontia*, and, in all stages of disintegration, as a result of its boring activity. There can be no doubt that there is every probability of large additions to our knowledge of the group by painstaking inquiry, both in the completion of the life-histories of the forms already made known, and in the discovery of new species.

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II.

An Address to the Museums' Association on the Museums of Dublin.[1]

ON behalf of those who, some months ago, formed themselves into a Reception Committee in order to make arrangements for this visit of the Museums' Association to Dublin, I have much pleasure in offering you a hearty welcome. Our only cause of regret is that more of the members have not found it possible to visit us on this occasion. Indeed it has been a great disappointment to those who have laboured to make this meeting a success to have received letters of apology from several whose urgent engagements have prevented them from being present with us to-night.

For the honour you have done me by electing me as your President for this year, I beg to offer you my sincere and grateful thanks.

The addresses of several of my predecessors have dealt with the general principles which should govern the administration of Museums; on the present occasion I propose to describe what may be referred to as the evolution of a Museum which has a very wide and comprehensive range—a wider range, perhaps, than any other Museum, putting the British Museum out of the question as being beyond comparison, and scarcely excepting even the great National Museum of America at Washington; for although our affiliated Museum in Edinburgh is in some respects more extensive, it does not include within its walls an archæological collection similar to ours.

In many cities, notably in Berlin, the process of decentralisation or specialisation of Museums has been carried to a considerable extent; and, while there may be much to be said in favour of specialisation where there are extensive resources to draw upon, on the other hand where this is not the case it cannot be denied that there are certain advantages to be obtained from centralisation.

In a comprehensive Museum no one section is wholly dependent on a single officer and a small staff, while all may derive advantages from co-operation. Uniformity and continuity of method are secured,

[1] This address was delivered on the 26th June by Professor V. Ball, C.B., LL.D., F.R.S.

and all branches receive the benefits which are derivable from the workshops, skilled artisans, and plant which can alone be efficiently maintained in a large central institution.

It is a minor, but at the same time an important, matter to remember, too, that miscellaneous contributions and bequests to an institution with many branches can generally all be dealt with and provided with proper places in the various sections; but such donations to a specialised Museum are often out of place, and cannot, or at least should not, be exhibited. Moreover, there are many objects which belong to the borderlands of Science or of Art, or of some of their distinct subdivisions respectively, and for such objects, instead of having one location, it may be necessary, wherever there are distinct Museums, to have several more or less complete repetitions. It will be admitted, I think, that, generally speaking, it is undesirable that two or more Museums in the same city should overlap in their ranges by exhibiting the same or similar objects, or by competing at sales for their purchase; the advantages of that state of things being indeed restricted to the sellers, none being felt by the public at large, whether as ratepayers or visitors to the Museums.

The position of our great central National Museum here may be compared to a river into which many tributaries have poured their contents; but to prevent any misconception from the use of that term, they should rather be called contributaries. Although the sources of the main stream in this case stretch far back into a now remote past, I purpose to deal with these contributaries first, giving brief sketches of each of them, and omitting such details as it would be tedious, even if it were possible, to deal with on the present occasion.

On the subject of Provincial Museums in Ireland I shall say very little. Attached to the Queen's Colleges at Belfast, Galway, and Cork there are Museums which are primarily intended for teaching purposes, but are also open to the public. At long intervals I have seen all of them, and each, I believe I am correct in saying, represents more or less the views of the Professors respectively who have had charge of them, controlled, no doubt, to a considerable extent by the amount of funds which have been available.

There are two other Museums in Belfast, namely, that belonging to the Corporation, and that of the Natural History Society. Already these and the College Museum overlap in some departments, which is perhaps unfortunate; but that is a matter which it is not for me to comment upon further here, as I know there are difficulties connected with it, and I do not venture to suggest a remedy, though what one suggestion would be is sufficiently indicated by the remarks made above upon our centralised system in Dublin.

Minor Museums exist in Larne, Armagh, Kilkenny, and possibly in some other towns; they owe their origins to the activity of local societies or of individuals, some of whom have passed away, and although they contain objects of interest and value, they include some

others which are rather out of place, and their development is hampered by lack of funds and other causes.

Although, through the kindness of the Rev. Dr. George Stokes, I have been placed in possession of much interesting historical information regarding the Scientific Societies of Dublin in the 16th and 17th centuries, some of which appear to have possessed collections, I have not as yet had the necessary leisure for following up exhaustively the clues which he has placed in my hands, nor, indeed, could I devote in this address the time and space necessary for doing full justice to the subject; but I have seen enough to prove that the task, if undertaken, will be productive of interesting results, and that it will show that in those early times a spirit of active scientific enquiry was already in existence in Dublin, in which such men as Sir Wm. Petty, Molyneux, Marsh, Pococke, Rutty, Madden, Keogh, Berkely, St. George Ashe, Robert Boyle, and others whose fame was not merely local, actively participated. Some of their contributions to science are well-known, having been printed in the early volumes of the "Philosophical Transactions." There was, indeed, a very intimate relationship at the time between at least one of these societies and the Royal Society of London.

Trinity College.

This grand institution, which for upwards of three centuries has maintained its high position, successfully accomplished the aspirations of its founders, and secured for itself respect and admiration all the world over as a centre of light and learning, has founded within its walls, and keeps still in active operation, several Museums which, with the progress of scientific education, have been gradually more and more specialised to meet the educational necessities of the present day, as follows:—

I.—Museum of Natural Philosophy.—Founded about the year 1730. It contains a collection of various philosophical instruments.

It is in the charge of the Professor of Experimental Philosophy.

II.—Museum of Anatomy and Zoology.—The Zoological Museum was founded in the year 1777, and contains a large series of typical specimens.

The objects of most general interest in this Museum are the skeleton of the Irish giant, Magrath, and the only existing Irish example of the Great Auk.

Many of the older specimens were formerly in the private Museum of the late Dr. Robert Ball, whose collections were merged in those of the University in the year 1844, and who, up to the year 1857, was Director of the Museum. It has since been in the charge of the Professors of Anatomy and Zoology.

The Anatomical collections, formerly combined with those of Pathology, are now arranged in the galleries of this Museum.

There is a Zoological Laboratory attached, and the building is close to the School of Anatomy.

III.—ANTHROPOMETRIC MUSEUM AND LABORATORY.—A portion of the Zoological Museum has been set apart for the above purpose.

IV.—MUSEUM OF GEOLOGY AND MINERALOGY.—This Museum consists chiefly of teaching collections of fossils, minerals, and rocks, but there are some fine specimens of the Irish Elk and of Reptilian fossils.

About the year 1850 the collections of the Geological Society were deposited in this Museum. Catalogues of the Mineral collection were published in 1807, 1818, and 1850. Formerly it formed only a section of the Natural History Museum, but it is now in the charge of the Professor of Geology and Mineralogy. Its first arrangement in an instructive and most attractive form, in its present habitation, in 1853, was carried out by the Rev. Dr. Haughton during the earlier years of his occupancy of the Chair of Geology.

V.—MUSEUM OF ENGINEERING MODELS.—Founded in 1846. It contains a variety of Engineering Models illustrating the progress of invention in the steam engine, the construction of bridges, etc.

It is in the charge of the Professor of Engineering.

VI.—MUSEUM OF SURGICAL AND MEDICAL PATHOLOGY.—Is intended for students in Medicine and to illustrate the Professors' lectures. It has recently been re-arranged and placed in a more spacious building attached to the Medical School.

VII.—HERBARIUM AND BOTANIC GARDENS.—The Herbarium contains:—

I. Plants of Great Britain and Ireland.
II. General Herbarium,
Also a laboratory for research and demonstrations.

The Herbarium is in the charge of the Professor of Botany, Dr. E. Percival Wright, who has recently published an interesting account of it in the "Book of Trinity College."

The College Botanic Gardens (situated in the suburbs) contain about eight acres of highly-cultivated ground, including several glass-houses.

VIII.—MUSEUM OF MATERIA MEDICA.—Contains specimens of drugs; is in charge of the King's Professor of Materia Medica and Pharmacy.

The Library of Trinity College has of late years developed a section of Antiquarian exhibits of considerable interest. Here may be seen the Book of Kells, the original of the Irish Harp, the so-called harp of Brian Boroihme (Boru), and many other treasures.

In the year 1868 a distinguished representative of the University, the late Dr. Henthorn Todd, stated in evidence before the Science and Art Commission which sat in that year that, while not committing the University, it was in his opinion its duty to aid a National

Museum by contributing by donation, or loan, such collections as it could spare without trenching on the teaching collections proper.

This view of their position has been practically adopted by the Board, and the following collections have been transferred to the custody of our Museum.

1863. 150 casts of Irish fishes, prepared under the superintendence of the late Dr. Robert Ball.

In 1882, a portion of Captain Cook's collection and the Haliday collection of insects.

In 1883, a collection of fossils and casts of fossils of mammals and reptiles from the Sivalik Hills.

In 1888, a large number of bundles of duplicates of exotic plants.

[In 1894, weapons and implements of the Cook collection, to be deposited on loan.]

All the above collections are arranged, and are, or will shortly be, open to the public. They have been labelled, and of some portions there are detailed printed catalogues.

The Royal Irish Academy.

The Royal Irish Academy was incorporated by Royal Charter of George III., on the 28th January, 1786, for the purpose of advancing the study of Science, Polite Literature, and Antiquities in Ireland. From its commencement it was considered by the Irish Parliament to be a proper object for public bounty, and it has since continued to receive Government aid in carrying out its work.

It has been said that a remark by Sir Walter Scott animadverting on the fact that Ireland contained no National Collection, although abounding in Antiquarian remains, was connected with the inception of the Academy's Museum. Be that as it may, we find that on the 24th June, 1839, a real beginning was made by the presentation to the Academy of the Cross of Cong by Professor MacCullagh, and of two gold torques, found thirty years before at Tara, and presented by Dr. Petrie, on behalf of the subscribers who had purchased them for this purpose. In their Report, dated March, 1841, the Council state that they consider that the formation of a Museum is an object which the Academy should continue steadily to pursue. A sum of money was allotted to the Museum Committee, and reference is made to a subscription just then raised of upwards of £1,000 to enable the Academy to purchase the collection of antiquities of Dean Dawson, of St. Patrick's. Space and time fail me to describe the acquisition by the Academy of the Petrie and other collections which were subsequently added. Even Sir Wm. Wilde's Catalogue, published in the years 1861–2, which served to spread abroad the reputation of the Academy's Museum, was not absolutely exhaustive of its contents.

In the year 1877, after some correspondence, the Academy

accepted the proposition of the Government that it should transfer its Museum to the Dublin Museum of Science and Art as soon as the building should be ready to receive it, one of the conditions being that it should be retained in Ireland for the benefit of the public.

The actual transfer of the collection to the new building did not take place till after the rest of the Museum had been opened to the public on the 29th August, 1890, but as the cases were ready for the reception of the specimens on their arrival, they were placed on view and the Gallery opened to the public within a fortnight's time after the move was commenced by officers of the Science and Art Department specially deputed for the purpose; and on the 29th October the lists of the specimens were duly signed in witness of the transfer having been accomplished.

Since then much has been done with reference to the better mounting and arrangement of the specimens in this collection, which naturally, as being the special production of Ireland, absorbs a large portion of the attention of visitors, for whose benefit and instruction a very detailed system of labelling with printed labels has been commenced.

To this great and most important section of the Museum I commend your special attention.

The Museum of the Royal College of Surgeons.

The history of this Museum covers about the same period as that of the College itself, *i.e.*, it was founded in 1784, and in 1795 the first catalogue was prepared. In 1820 it was decided to form a Natural History Museum, in addition to the collection of Anatomical preparations. As a very full account of this Museum exists in the "History of the Royal College of Surgeons," by Sir Charles Cameron, it is not necessary to give further details here. To our Museum it has contributed some specimens; among them may be mentioned a collection of fossil bones, and casts of fossils of Sivalik Mammalia.

But the most important contribution was its Curator, the late Dr. Alexander Carte, who, in 1851, was transferred to the Royal Dublin Society as Director of their Museum, and with it he subsequently passed into the service of the Science and Art Department in 1877.

Geological Society of Dublin.

The first annual meeting of the Society was held on the 8th February, 1832, an address being given on the occasion by the Rev. Bartholomew Lloyd, D.D., F.T.C.D., President of the Society.

During the following quarter of a century or so, the Society acquired a collection of rocks, fossils, and minerals, which, about the year 1850, was deposited in the Museum of Trinity College, where for many years the meetings of the Society were held.

In the year 1864 the Society's title was enlarged by a "Queen's Letter" to that of The Royal Geological Society of Ireland. For the

last few years its operations have been in abeyance, no meetings having been held.

The Royal Zoological Society of Ireland.

This Society, founded in the year 1832, though not ostensibly connected with the formation of a museum, has in two capacities contributed very materially to the acquisition of specimens, besides which it may be claimed for it that it has in a very important degree served to maintain a vigorous interest in practical zoology in our midst. Here first, for instance, was the practicability demonstrated of exhibiting living pictures to the public of the subaqueous existences of the lower orders of animal life. In spite of subsequent claims which have been made, it is known to those competent to speak with authority that the late Dr. Robert Ball invented, and so far back as 1854 put in practice at the Zoological Gardens, the system of Aquaria which has since received such a wonderful development throughout the world. The original building in which the tanks were let into the wall and were aërated by an ingenious device, still exists in the gardens, though now used for another purpose. Of the two ways in which the Zoological Society has contributed to the formation of Museums the more obvious is, of course, in the supply of specimens of animals which have died in the gardens. Of them a goodly number have found their way either to the Museum of Trinity College, that of the College of Surgeons, that of the Dublin Society, or its successor the Science and Art Museum. Not only have specimens for stuffing been thus provided, but anatomical subjects, including anthropoid apes, the larger carnivora and elephants, have, in the hands of Haughton, Macalister, Cunningham, and others, afforded most important results. As the recipient of donations and bequests of collections and valuable specimens, which have been transferred to our Museum, the Zoological Society also deserves to be mentioned. And in this connection the magnificent and unique specimen of *Plesiosaurus cramptoni*, presented by the late Sir Philip Crampton, and a fine collection of Irish birds, bequeathed by the late Thomas W. Warren, may be referred to.

Natural History Society of Dublin.

This Society was founded in 1838 for the sole object of elucidating the natural history of Ireland. It was proposed to effect this by making a standard collection of specimens and by holding meetings. The collections grew rapidly, and they were for a time open to the public; but financial pressure rendered it impossible to continue this and, at the same time, meet the cost of publishing the papers read at the meetings.

In the *Proceedings* of the Society for November 13, 1857, and *Nat. Hist. Rev.*, vol. v., 1858, there will be found an enumeration of the specimens contained in the Museum.

By the close of the year 1869 the Society was obliged, by want

of space, to adopt measures for the disposal of its collections and library, and subsequently, about the year 1880, some of the rarer stuffed birds were transferred to the Dublin Society's Museum. Since then the Society has suspended operations. But the Naturalists' Field Club is now a flourishing young society.

GEOLOGICAL SURVEY.

The Geological Survey commenced existence as a branch of the Ordnance Survey in 1832. It was placed under the charge of Captain Portlock. Large collections were made of zoological and botanical, as well as of geological, specimens. In 1844 the Government of the day detached the Geological from the Ordnance Survey, and created it into a separate branch, Sir H. T. De la Beche being appointed Director-General.

As provided for in Lord Sandon's letter of the 9th February, 1876, the collection of the Geological Survey, consisting mainly of specimens of the rocks and fossils of Ireland, together with a few British and foreign examples for comparison, was transferred from the College of Science during the year 1890, to the gallery in our Museum specially prepared for its reception. On being thus for the first time fairly spread out for examination, it became apparent that there were not a few gaps, but these have been to a large extent since supplied by the labours of the officers of the Survey, in whose custody the collection still remains. And a very interesting and instructive collection you will find it now to be.

MUSEUM OF IRISH INDUSTRY.

It was decided by her Majesty's Government in 1845—Sir R. Peel being Prime Minister—to establish in Dublin an institution somewhat on the plan of the Museum of Practical Geology in London, but more extended in its objects, as it was to embrace the general range of the Industrial Arts. Lord Castlemaine's house in Stephen's Green was taken for the purpose. The preparations of the galleries lasted from 1847–1852.

In addition to the more purely Exhibitional Department, situated in the galleries, there were at first established as portions of the institution:—

1. A Government School of Science applied to Mining and the Arts.

2. A Chemical Department, with laboratories, first termed "Museum of Economic Geology," afterwards changed to Museum of Industry. In 1853, it was transferred from the Department of Works to that of Science and Art, then newly created as a branch of the Board of Trade.

This Museum was abolished as such in the year 1865, and certain of the collections have since been transferred to our National Museum collection.

The Science and Art Museum.

The early history of this Museum, for nearly a century and a half previous to the year 1877, when it was transferred to the Science and Art Department, forms a part of the general history of the Royal Dublin Society, and I propose, therefore, in the first place, to give a sketch of the history of the Society, with special reference, however, to the inception, growth, and development of the Museum, which constituted but one department of the Society's many-sided functions.

The Society had its origin in a private association, formed in the year 1731 by fourteen citizens of Dublin, for improving husbandry, manufactures, and other useful arts and sciences. This association was incorporated by charter of George II. in 1749, and was granted a yearly sum of £500 out of the privy purse.

On the 22nd of February, 1733, the Museum was first opened to the public. Its contents then consisted chiefly of agricultural implements and models of flax and cider mills, which, with the permission of the Lords Justices, were exhibited in a vault under the House of Parliament. The first eight meetings were held in Trinity College, in the rooms of the Philosophical Society. Afterwards one of the committee rooms of the House of Parliament was used for the same purpose.

The first regular place of meeting by the Society was acquired in 1756 in Shaw's Court, from whence it removed in October, 1767, to Grafton Street, and thence again in 1796 to Hawkins Street, where a specially built edifice afforded accommodation to the Museum, laboratories, etc.

In 1761 the Society received its first Parliamentary grant, and since that time many special, besides annual, grants have been made, which were entrusted to the administration of the Society for the benefit of the public. During the latter years of the last and the early part of the present centuries the Mineral collection received many acquisitions both by purchase and donation, and for a long time it formed the most important part of the Museum.

In 1790 Parliament directed (30 Geo. III., c. 28) that a Botanic Garden should be formed, and in 1792 a cabinet of Mineralogy was sanctioned, and in the following year a sum of money was granted (33 Geo. III., c. 13) for erecting a suitable repository for it.

In 1800 the Society received a grant from the Irish Parliament of £1,500, and for twenty years after the Union the income amounted to £10,000 (Irish currency) per annum. The resources of the Society were so far husbanded that in December, 1814, it was enabled to purchase Leinster House from the Duke of Leinster for £20,000, and in the following year the collections were transferred there. By the removal of the National Library to the new buildings in 1890, the rooms of that splendid mansion have been freed from the cases which concealed so much of their noble proportions and artistic decorations. The rooms have been restored of late years, and now present an

appearance the beauty of which you will have an opportunity of seeing during the next few days.

In 1819 the grant to the Society was reduced to £7,000.

In 1820 the Society assumed the title "Royal" on the occasion of George IV. becoming the patron, and in 1832 the Lords of the Treasury directed a reduction in the Society's estimates to the amount of £1,600, and that the apartments and collections should be rendered accessible to subscribers, who need not be elected members of the Society.

In the year 1836 a Select Committee of the House of Commons reported in favour of an extension of Leinster House, in order to afford increased museum accommodation and recommended an expenditure of £3,000 for this purpose. It was, moreover, affirmed to be expedient, in reference to future grants of public money, that it should be fully understood that the members of the Society must be regarded as trustees administering public money, and that a clear and distinct guarantee should be given by the Society that the public were entitled to the full and entire use of the property. In response to a special request by the Treasury, this view of the position of the Society was admitted by a resolution passed on the 22nd of December, 1836, and on the 11th of May, 1837, a further resolution of the Society affirmed that, in consideration of the Parliamentary grants made to the Society, it was just and reasonable that it should not alienate any of its property without the approval of the Lords of the Treasury.[2]

In the year 1840 the Irish Government entered into correspondence with the Society, pointing out that it had not carried out certain recommendations with regard to its development as a scientific institution, to which the Society replied that it was not, nor was it ever intended to be, a scientific body; but in this respect its intentions have since undergone considerable change. In 1841 the Parliamentary grant was withheld, but was restored in the following year. In the same year the Society established an Agricultural Museum; in it the principal objects were implements, seeds, models of fruits, vegetables, and veterinary preparations. In 1844 a sum of £150 was voted for the annual support of this Museum.

In 1842 a special extra sum of £300 was voted by Government to the Society for the purpose of providing gratuitous public lectures in provincial towns—a system which had been first established in 1839 The regular annual grant to the Society at this time was £5,300.

In 1843 the Society memorialised the Government for a special grant of £3,000 for the formation of a National Museum, and £4,000 for renewal of buildings in the Botanic Gardens. In this memorial it was pointed out that while the annual grant had diminished from £10,000 in 1800 to £5,300 for the current year, that to the British Museum had increased from £3,000 in 1804 to £81,000.

[2] According to a Treasury Report, issued in 1876, the public grants made to the Society between 1801 and 1835 inclusive amounted to £293,705.

Already part of that sum of £3,000 had been expended by the Society on the building for the new Museum, but the grant which was applied for was refused by the Lords of the Treasury, and the building when completed was never used as a Museum, having, in the year 1849, on the recommendation of Mr. Poynter, been handed over to the new School of Design under the Board of Trade. As it had been built by the Society, a claim for a compensatory grant was put forward, and in 1853 the Government voted a sum of £5,000, provided half that amount was raised by public subscription, for building a Natural History Museum. It was proposed to make it a truly National Museum, and an efficient adjunct to the "educational functions of the Society, and especially to the Schools of Art." The foundation of the Museum was not laid till three years later, namely, on the 7th of April, 1856, the ceremony being presided over by Lord Carlisle, who was then Lord Lieutenant. As had been fully provided by Act of Parliament (17 & 18 Vict. c. 99), its design was in harmony with that of the intended National Gallery, which was also to contain Marsh's Library.

Dargan's Great Exhibition was held on the Society's grounds in 1853, but it is no part of this account to deal with it, nor with any of the other exhibitions and shows which have been held under the Society's auspices.

In 1854 the Society first commenced to report its operations to, and was placed under the Science and Art Department of, the Board of Trade.

At about this period the Museum of Irish Industry had developed somewhat beyond its originally intended scope as a technical Museum; this led to some controversy with the Royal Dublin Society, which was intensified by the fact that the professors had been transferred from the Society to the first-named institution.

In 1857 the completion of the building of the new Natural History Museum, on the occasion of the visit of the British Association to Dublin, was inaugurated by the delivery of lectures by Sir Wm. Thompson on the Atlantic Telegraph Cable, and by Dr. Livingstone on his African discoveries.

In 1858 an Exhibition of Decorative Art was held in the new Museum, to which a loan collection was contributed by the South Kensington Museum.

In 1859–60 the Natural History Museum received important loans from the Royal Irish Academy and from the Royal Zoological Society. A well-known collection of shells, by bequest from Thomas W. Warren; donations of birds and insects from British Columbia, by Dr. (afterwards Sir) Charles Lyell; and a highly valuable collection of Arctic mammals, birds, fossils, and minerals from Captain (afterwards Admiral Sir) Leopold M'Clintock, who continued for many years to be a contributor to the collections, were also received.

Much pressure was at this time used by the Government, even

to the extent of threatening to withdraw the annual grant of £6,000, in order to induce the Society to consent to open the Botanic Gardens at Glasnevin on Sundays. At last the Society consented, and on Sunday the 18th August, 1861, the first opening took place, and the total attendance for the first twelve Sundays amounted to 78,132.

In 1862 a report on the Society was drawn up by a special committee, in which its position and its past relations with several departments of the Government were discussed, and the question as to whether it was a private body or a public institution, chartered for the administration of public funds, was specially dealt with. In this same year a Treasury Commission was appointed to inquire into the Society and other analogous institutions in Dublin, which were supported wholly, or in part, by public grants, and to report thereon.

During the year 1863 the enlargement of the powers of the Council by charter, and a proposal for amalgamation with the Museum of Irish Industry, which had been founded in the year 1845, were discussed.

In consequence of the lack of funds for additional case accommodation, very slight progress was made during the year in the permanent arrangement of the Museum. The Society presented a special memorial for the grant of a sum of money for perfecting the several institutions as follows :—

Museum of Natural History	£4,500
Library	1,000
Botanical Museum and Garden, Glasnevin	1,000
Agricultural Department	3,000
Total	£9,500

This sum, it was understood, had been considered requisite by the Treasury Commission, which had reported as above in 1862. The delay in its recommendation to Parliament arose from the fact that the question of the future position of the Museum of Irish Industry was still under consideration.

In 1864 a Parliamentary Select Committee assembled, on the 20th April, to enquire into the Scientific Institutions of Dublin which received aid from the State. One object of this enquiry was to obtain a revision of the Treasury Report of 1862, and of certain recommendations therein specified, the most prominent of which were :—

I. The amalgamation of the Museum of Irish Industry with the Royal Dublin Society, and the reduction of the staff of lecturers and teachers.

II. The amalgamation of the pecuniary grant to the Royal Dublin Society.

In 1867, Dr. Alexander Carte being then the Director of the Natural History Museum, the staff was increased by the appointment of two

Assistants, Messrs. A. G. More and W. F. Kirby, both of whom, as is well known—especially the former—did much good work for the Museum. Mr. Kirby subsequently received an appointment in the British Museum.

Towards the end of 1867 considerable progress had at last been made in the arrangement of the collections, and numerous valuable donations were received. In the following year, 1868, the first steps were taken towards opening the Museum in the evenings—one evening, Wednesday, being selected as an experiment—otherwise the Museum was only open for four days in the week.

It may be of interest to record here, in connection with the project of establishing a Department of Science and Art in Ireland, that "A Memorial from 245 Students of the School of Art, was addressed to the Lords of the Treasury, praying that, in the event of a Science and Art Department being established in Ireland, the present right of Irish Students to compete with those of England should be preserved."

In September the Council was informed that a Commission had been appointed "to consider the establishment of a Science and Art Department for Ireland." The report of this Commission contains much interesting information. It decided against the formation of a local Department, and sketched out a plan for the establishment of a State Museum.

In 1869 the question of opening the Museum on Sundays was under consideration, but action was deferred, and in fact the proposition was not carried out till the year 1884, or 15 years afterwards.

In 1870 the Department of Science and Art, pending negotiations which were in progress, declined to recommend Parliament to vote a sum for the erection of a Museum of Ornamental Art.

The acquisitions of the Museum in this year were again very considerable.

It was resolved to open the Museum on two evenings in the week (Mondays and Thursdays) and to close it altogether on Tuesdays and Fridays. Afterwards these days were altered.

The evening attendances far exceeded those in the day, having been 89,338 and 13,899 respectively, or an annual total of 103,237. On one evening upwards of 3,000 persons attended, and some confusion was caused by the consequent overcrowding.

From a report by the Committee of Natural History, it would seem that there was much dissatisfaction with the Natural History building. It was stated to be in several respects unfitted for the use to which it was applied, and was not on a scale worthy of being called national. The Committee also claimed that the officers should be put on the same footing, as regards salaries, as the corresponding officers in the British Museum.

In 1872 the *Proceedings* of the Society contained a report by

a committee appointed to consider the question of a General Museum of Science and Art in connection with the Society. It concurred in the opinion of the Commission which met in Dublin, 1868, "that the formation of a separate Department for Ireland would be detrimental to the interests of Science and Art in that country." It then refers to the proposal of the Commission that the several proposed institutions should be concentrated on one site, namely, a Science and Art Museum, a Public Library, a Museum of Natural History, a Museum of Irish Antiquities, a National Gallery and a School of Art.

Plans were prepared by which it was shown how this object might be attained on the Society's premises by the incorporation of Leinster House, and the connection of its first floor as a means of communication between the proposed buildings. The committee demurred, however, to the control of these institutions being transferred to another authority.

The Lord Lieutenant, Earl Spencer, to whom the report was forwarded, expressed himself strongly in favour of the establishment of a "General Museum of Science and Art," but considered that the plan would not be perfect without the co-operation of other societies.

The most important donation to the Museum during the year was made by Sir Richard Griffith. It consisted of his unique collection of Irish fossils (Carboniferous and Silurian), which contains nearly all the typical examples described by M'Coy and Salter in their "Synopses of the Carboniferous Limestone and Silurian Fossils of Ireland," respectively. It serves to illustrate the state of palæontological science at the time of the publication of Sir Richard Griffith's large map. It is now well placed for inspection in the Palæontological Gallery.

In a report by the Council of the Society, read on the 5th of March, 1874, the delay in providing funds to meet several urgent applications, and in the provision of the new Museum, etc., is animadverted upon.

A committee appointed to report on the question of the extension of the buildings for the Museum, Library, etc., confirmed, except in some minor details, the report of the committee of 1872.

The premises of the Society were visited and inspected on the 7th of December, 1875, by the Right Hon. Viscount Sandon, M.P., Vice-President of the Committee of Council on Education, Mr. W. H. Smith, M.P., Secretary to the Treasury, the Right Hon. Sir Michael Hicks-Beach, M.P., Chief Secretary for Ireland, and Major (now Major-General Sir John) Donnelly, R.E., with reference to the increased accommodation for the Museum and Library, and the formation of a general Museum of Science and Art, and a letter was received by the Society on the 17th of February, 1876, from Lord Sandon, relative to the establishment on the Society's premises of a general Museum of Science and Art. An objection was at this time raised by the agent of the

Pembroke estate to the proposition, then current, to erect the buildings for the new Museum on Leinster Lawn. Various deputations from the Society to the Lords of the Committee of Council on Education, for the purpose of discussing the terms of Lord Sandon's letter, took place at this time.

A proposition which was made, for the amalgamation of the Royal Irish Academy with the Royal Dublin Society was put forward during the year, in the hope that it would facilitate the settlement of the pending question as to the new Museum, but it did not meet with acceptance.

The *Proceedings* contain several references to the bequest by the late Mr. J. H. Foley, R.A., the eminent sculptor, of his models of statues, busts, etc., to the Royal Dublin Society.

On November the 18th a letter was received from Mr. W. H. Smith, Secretary of the Treasury, stating that it was intended to obtain an Act of Parliament "to vest all the buildings and land now held by the Royal Dublin Society in the Government" in order "to afford the State the requisite control over property and buildings upon which a large amount of public money is to be expended."

A resolution was thereupon passed by the Society to the effect that it was desirable to facilitate the acquisition by Government of the sites necessary for the several institutions, provided that "the rights of existing members be preserved undiminished."

The volume of *Proceedings* of the early part of the year 1877 contains frequent references to the negotiations which were carried on between the Society and the Government in reference to the establishment of the Science and Art Museum.

An agreement supplemental to the provisions of Lord Sandon's letter was entered into between the Government and the delegates appointed by the Society, by which several important concessions were made in consideration of the property and rights hitherto possessed by the Society, but which were now relinquished; and accommodation for the Society in Leinster House was secured to it on the same terms as govern the occupation in Burlington House by learned societies.

By a letter of the Science and Art Department, dated 9th August, Dr. Steele was appointed to carry on the administration of the Natural History Museum, School of Art, Library and Botanic Gardens, as soon as the Bill should receive the Royal Assent. He was to have the same authority of administration as had been exercised by the Council of the Royal Dublin Society, except as regards the appointment of superior officers; and the funds for carrying on the work were to be those provided in the current estimates.

The total of the grants which had been entrusted to the Society for administration on behalf of the public, inclusive of Public Works vote, amounted, from 1801 to 1877, to £627,056; the regular income

of the Society from members' subscriptions for the same period having been about a tenth of that sum, and the subscriptions for special purposes having yielded about £4,000.

Having thus brought down the history to the year 1877, when the complete transfer to the Government of the buildings and collections was concluded by the payment to the Society of a total sum of £35,000, including compensation for disturbance of the cattle shows, which formerly used to be held on the premises, I now proceed, I fear somewhat imperfectly, because of necessity briefly, to describe what the main features of the collections were which were so transferred.

These consisted mainly of zoological specimens in the Natural History Museum which had been acquired during a long course of years by donation and purchase. There was also an extensive Mineral collection, though not up to date. There were numerous isolated Geological and Palæontological collections, for the exhibition of which but limited space had been available; these included Sir R. Griffith's collections, and several valuable collections from the Arctic regions. There was a nucleus of an Ethnographical collection, a few antiquities, and some other miscellaneous objects, besides a collection of agricultural implements, veterinary specimens, and seeds, and a Botanical collection and Herbarium in the Botanic Gardens. The Art collections consisted mainly of casts and water-colours in the School of Art, and there was the then unsecured reversion to the Foley Collection of Casts.

The First Annual Report of the first Director of the Science and Art Museum, Dr. William Edward Steele, who for 25 years previously had been Assistant Secretary and Registrar of the Royal Dublin Society, was dated January, 1879, and it covered the period from the 14th August, 1877, when the Dublin Science and Art Museum Act passed, up to the close of 1878. It describes the initial steps taken in the formation of the Art Department of the Museum, which has since then grown to such important dimensions that it almost fills the large building completed for its reception less than five years ago. A special loan collection of scientific and art objects was prepared for exhibition in the old Museum on the occasion of the visit of the British Association in 1878.

In that year a local Board of Visitors of the Museum and Botanic Gardens was appointed, in accordance with the terms of Lord Sandon's letter above referred to.

During the year 1879 the want of space for exhibiting the growing art collections was keenly felt. Mr. Longfield was appointed to assist the Director in this department of the Museum. Among the acquisitions were the Foley casts, to which reference has already been made. For the Natural History Department the unique fossil of *Plesiosaurus cramptoni*, which had been lent to the Museum in the year 1861, was purchased from the Zoological Society. There were also many other purchases and presentations.

In 1880 the question of the site for the new Museum was under discussion, and the opposition to the proposed site on Leinster Lawn, principally by certain inhabitants of Merrion Square, led to its abandonment in favour of the other (west) side of Leinster House.

In this year the Ethnographical collection, to which some important additions had then recently been made, was taken in charge by the Art Department of the Museum, and was re-arranged and labelled. Already it formed a nucleus around which the considerable acquisitions of the last fourteen years have since been added, and it now constitutes a very important section in the new Museum building.

In the year 1881 a number of architects submitted designs for the new Museum, and some of them were selected to make detailed plans for the final competition.

In this year Dr. Alexander Carte died. For thirty years he had controlled the Natural History Museum. Among other original devices of his for the better exhibition of specimens was the beautiful arrangement of the birds, which is still in operation as he left it. It possesses manifold advantages over the shelf system, adopted in most Museums. He was succeeded by Mr. A. G. More, his senior assistant.

In 1882 unavoidable delays arose to postpone the first steps being taken towards the erection of the new Museum; but by the close of the year the temporary gallery for the reception of the Art collections was nearly completed, and it was opened to the public about six months later.

Among other acquisitions which were received was an important addition to the Ethnographical collection, consisting of a portion of Captain Cook's original collection of South Sea Island weapons, dresses, etc., presented by Trinity College. A valuable donation of Sèvres China was also received from the French Government. In the Natural History Department the invertebrate collections were re-arranged, and their educational value increased by the addition of glass (Blatschka) models, geological charts, etc.

In May, 1883, the Director of the Museum, Dr. William Edward Steele, died, having devoted nearly six years of anxious and untiring service to the foundation of the Art Department of the Museum, and to the many intricate questions connected with the transfer from the Society to the Science and Art Department, of the Museum and the other institutions with which the office of the Director is connected.

In September of the same year, being at the time Professor of Geology and Mineralogy in the University of Dublin, I was appointed to succeed the late Director, and here, perhaps, I may be permitted to refer to a fragment of personal biography. For reasons I need not enter into, the position of Director of the Museum, with the numerous extra responsibilities connected with three other institutions, namely,

the School of Art, the National Library, and the Botanic Gardens, was well known to be one of some difficulty and responsibility, and my reason for accepting it, and relinquishing a post of much greater ease and freedom of action, was mainly this, that the management of a Museum of wide range had been, I may say, the dream of my life, and the occasions when I had temporary charge of Museums in India, including that of the Imperial Museum in Calcutta, which had been just then transferred from the Asiatic Society of Bengal to the Government, under circumstances similar to those I have described above, only whetted my long-cherished desire for a permanent appointment of the kind.

In what I have to say regarding the further stages in the evolution of this Museum during the past eleven years, I shall pass without mention the difficulties which have had to be met, and the controversies they have given rise to; much as they have added to our labours and anxieties, they are not matters suitable for introduction here, but the curious may find them, or some of them, recorded elsewhere.

One of the first steps which I found to be necessary was the extension of the already established workshops in connection with the Museum; and soon after a printing press was provided, by which printed labels could be speedily prepared on the spot, and the educational value and, so to speak, the self-explanatory character of the collections extended.

Shortly afterwards application was made to the Lords of the Committee of Council for permission to open the Museum on Sundays. This was immediately granted; and the proposition, it may be added, met with no opposition whatever from any quarter, but, on the contrary, was hailed with delight by the public, who have since availed themselves of the privilege in ever increasing numbers. This was in 1884, or just ten years ago, and as in the case of the three other institutions in Dublin, which were first opened on Sundays many years earlier, with two of which I am also officially connected, the movement has been an unqualified success, and a boon which is much appreciated by the public. I very well remember the terms of approbation in which it was spoken of by the visitors when they were interrogated on the first few Sundays after the first experimental opening. Among them were working men who had never been inside the walls of the Museum before, and others who voluntarily explained that their usual occupations on Sundays consisted in driving about on cars, with an occasional visit to a public-house. It may be asked by some, How about the employment of labour on Sunday? To it I can reply that no compulsion whatever has been used. The rate of Sunday pay being liberal, we find plenty of volunteers from among the staff to supply frequent changes of a sufficient number to take Sunday duty in turn. These facts have been placed before the Society in London which has the

opening of Museums and similar institutions on Sundays in view, and my sole reason for not having taken any more active part in the operations of that Society than I have done is, that my hands are already sufficiently full with my own work here. I observe, however, that the procedure of that Society appears to have made less headway against opposition than might have been expected from the time it has been in existence.

If Dublin is, as I believe it to be, fairly free from rowdyism and disorder on Sundays, I think it may be to some extent due to the large numbers of persons who are tempted to take their families to the various resorts in and near the city, where they can enjoy so much innocent pleasure and instruction as the institutions referred to can afford.

In 1884 further temporary accommodation was provided, by which the overcrowding in both sections of the Museum was relieved, and space for new acquisitions was provided. The printing of regular quarterly acquisition lists in such a form as to be capable of being cut up into labels was commenced, and has been continued ever since. This was in addition to the descriptive labels printed in the Museum press, to which reference has just been made. A slight increase to the staff of the Art Department, by the appointment of a Technical Assistant, was sanctioned, and the employment of experts to catalogue special groups though not initiated was advanced a stage, so as to become a very important accession to the powers of the limited staff of the Museum. In this way we have since had the advantage of the services of Mr. R. Lydekker on two occasions, the late Mr. William Davis, Mr. Kidston, and Mr. Foord, who have respectively prepared catalogues of and arranged portions of the Palæontological collections; while Mr. W. F. Wakeman and Mr. George Coffey have dealt similarly with the antiquities and coins; Dr. Will, of Erlangen, with the Coleoptera, and Mr. Greenwood Pim with the Lichens. Besides this, there have been volunteer experts who have arranged minor groups.

Of the advantages to be derived by Museum officers from visiting Museums in other countries than their own, I can speak from the experiences of my colleagues and myself. I hardly ever visit a Museum, no matter how small it may be, that I do not see some object of interest, or some method of exposition that is suggestive, either of imitation, or, perhaps, even of avoidance, for it is almost equally important in Museum management, as indeed it is in other affairs of life, to know what *not* to do, as to learn what it is advisable to have done!

Referring to my own visits to Museums, I derived, I think, more direct and immediate benefit from those of America and Canada, in the year 1884, than from those of the continent, including Berlin. There is an originality of conception and method, and a breadth in execution which render the Museums of Washington,

New York, and Cambridge (Boston), particularly instructive for one who had to reorganise an old, and initiate an orderly system in a new Museum. In many of the minor Museums which I visited in the States and Canada, I also acquired suggestive ideas, which have, in due course, produced satisfactory results. [3]

In the year 1885, the principal events here were connected with the completion of the plans for the New Museum and Library, and the laying of the foundation by His Royal Highness the Prince of Wales, on the 10th of April, the ceremonial connected with which having been witnessed by about 8,000 persons.

In the latter part of the same year, the lower hall of the Natural History Museum, which had previously been the receptacle of many miscellaneous objects, was reorganised, scattered collections of reptiles, fish, and fossils being brought together and systematically arranged in suitable cases; but this work was not wholly completed till the year 1890, when the fossils were removed to the gallery vacated by the Art Collection. During the same year, Mr. A. G. More's list of Irish Birds and several other publications referring to the collections were issued, and arrangements were concluded with the Science and Art Department for the publication of Miss Stokes's "Arts of Christian Ireland."

In 1886, the work of concentrating the collections in the sections assigned to them was vigorously pressed on. The general reference series of birds' skins, belonging to about 5,000 species, was provided with glass topped drawers, and a cast of the skeleton of the Megatherium was successfully mounted. An arrangement was also made by which the majority of the specimens obtained in a dredging expedition off the West Coast of Ireland, organised by the Rev. William S. Green, were to become the property of the Museum.

In 1887, the New Museum Building had acquired sufficient form to admit of a scheme of allotment of its twenty-four rooms and two courts with their galleries. This scheme, with but slight modification, has been carried out in the arrangement of the collections; needless to add it facilitated the transfer, as each object, when leaving its old quarters, had a definite destination, and so the rooms were filled concurrently, and we were able to open to the public much sooner than would otherwise have been the case.

The scheme of allotment, with lists of the principal contents of each section, will be found in the General Guide to the Museum, to which reference can easily be made, so that the details need not be given here.

A very important alteration in the casing of the Mammal collection in the Natural History Department, by which the specimens were brought forth from the darkness of cases under the

[3] See Appendix to thirty-second Report of the Science and Art Department, 1885.

gallery into the light of their present position, was commenced, but took some time to accomplish.

Preparations were also set on foot for the exhibition of Groups, showing the breeding habits of birds, and for providing maps to illustrate the geographical ranges of individual species.

Mr. A. G. More, Curator of the Natural History Department, was compelled to retire owing to ill-health, and Dr. Scharff, the present Keeper, was appointed to succeed him.

In 1888, many very important purchases were made, and the assistance of experts in the arrangement of the collections was largely availed of.

On the 4th of November, 1889, the completed New Building was handed over by the contractors, and the work of transfer of the collections was immediately commenced. Considerable purchases were made at the Paris Exhibition.

The year 1890 was memorable, from the fact that, on the 29th of August, the New Museum was opened to the public by the Lord Lieutenant, Lord Zetland, the occasion being celebrated by a suitable ceremonial, at which a large number of persons were present. In spite of the extra work thrown on the staff, a considerable amount of other work, such as the preparation of a General Guide Book and several special handbooks, was accomplished.

Later on in the year, after the official opening, the collection of the Royal Irish Academy was transferred, as has been related on a previous page.

In the Natural History Department, the arrangement of the special collections to illustrate geographical distribution and evolution was commenced. These now constitute a notable feature in the Museum.

The Electric Installation, commenced during the year 1890, and completed in 1891, has proved a very great success. It has not as yet been extended to the Natural History Museum, where we are most anxious to be freed from the deleterious effects on the specimens caused by the gas.

The evening opening of the Museum, though the attendances are fairly good in regard to numbers, is, perhaps, from some points of view, not so satisfactory as the Sunday opening. It is, indeed, true of both that many of the visitors are less intent upon seeing the collections than they are on meeting their friends, and the crowds of people who use the place as a promenade interfere somewhat with the comfort of those who desire to view the exhibits; but a decided improvement in the quality and conduct of the evening visitors was secured some years ago, by altering the hour of closing from ten o'clock to nine o'clock, and it is difficult to devise a plan by which mere promenaders could be excluded from an institution which is open to all respectably-clad persons. The police and attendants

cannot well do more than restrain openly unseemly conduct should it ever take place.

And here it may be stated that this Museum differs from most others in the fact that it is open free to the public for every day in the year save two, namely, Christmas Day and Good Friday, the necessary cleansing being accomplished daily before the opening hour, or after the closing hour, by the regular staff; and I think it will be admitted that the Museum presents no signs of neglect in this respect.

With our own skilled artisan staff we succeeded in suspending the skeleton of a large whale, weighing about six tons, under the roof of the Natural History Museum, where it is well seen, and no longer encroaches on valuable space, as it did when supported on pillars in the basement hall. The method of suspension can be freely commended for adoption in other Museums. Your attention may also be directed to the methods of shelving devised for the Mammals and for the Palæontological Gallery; they have many manifest advantages respectively.

During the same year we received on deposit, which was afterwards changed into a permanent donation, the life-size model by the late Mr. Birch for a proposed bronze statue of Lieutenant Hamilton. The incident which this statue records, namely, the attack on the Residency at Kabul, in the year 1879, is vigorously represented by the figure of that gallant young Irishman; and the statue has been, I may add, since its erection, an object of special attraction to many visitors.

In the year 1891, some long-deferred additions to the strength of the staff were at last sanctioned; these would have been still more acceptable had they been made in response to our earnest appeals before the extra pressure of the previous two years came upon us.

Under the temporary custody of Professor Johnson, which was afterwards changed in 1892 to a permanent charge, the Herbarium and Botanical Museum advanced considerably, and, indeed, in all Departments great progress was made.

The total attendances for the three years were as follows:—1889, 218,880; 1890, 313,564; 1891, 344,071; and the Sunday attendances were 1889, 40,599; 1890, 61,386; and 1891, 58,000.

In the years 1892, 1893, and 1894, the work of arrangement has also progressed in all branches, but there are no very special circumstances to be recorded here. Additions as they arrived have, so to speak, dropped into the sections provided for them, and the various arrangements for the good order and smooth working of the Establishment have operated, I believe, with satisfaction to all those who are immediately concerned. The public attendances in 1892, 343,714, were very close to those of 1891; and in 1893 they reached their maximum, namely, 367,645, or an average of over 1,000 a day, although the Sunday attendances fell from 57,536, in 1892, to 51,894,

in 1893. During the current year the total attendances promise to be very much larger.

In preparing the lines upon which this Museum should be arranged, both with regard to its then present condition and future acquisitions, we encountered from one quarter some opposition to the idea of our having any legitimate aspirations beyond those of making it a teaching Museum, which would exhibit only such types as were requisite for instruction in the various branches with which it dealt. But it appeared to us that our proper duty under the circumstances, while by no means losing sight of the educational aspect, was to steadfastly keep in view the desirability of making it a repository, in the fullest sense of the term, of all such objects as might fitly find a place in a national institution; and that, not merely in the sense of representing the productions and industries of this country of ours, but in the wider sense of providing for the nation a means of seeing and studying the productions of the world at large, and the arts of many nations, these, as examples for imitation, to be the best of their kind attainable with the means at our disposal.

While we endeavour to provide, both for our own fellow countrymen and for visitors, fitting exhibits in all branches of Irish decorative-art, antiquities, and science, we are also glad to say that our efforts to provide exhibits from other countries have often met with warmly-expressed approval, and we rejoice now at the prospect of their being examined by the experts whom this Association has brought together.

There is one Section which is not and cannot be largely dealt with in such a Museum, namely, that of purely industrial objects. For these, we are convinced, periodical exhibitions afford the proper medium for making them known. In such exhibitions, the exhibits can, and do, keep pace with the times, whereas in a Museum they must of necessity be in some departments far behind the progress of invention, as frequent renewals up to date would be impracticable; while in other departments it would be impossible, even with enormous financial resources, to exhibit at all. How, for instance, not to speak of minor industries, could we exhibit steam or electric plant so as to be constantly up to date?

Anxious that this National Museum might be made to spread its influence over a wider area than the metropolis alone, I sometimes dream of projects by which peripatetic loan collections might be sent out from it to provincial centres in Ireland, but so far the project is in a visionary stage without concrete form. But if it is the case that as yet collections cannot be sent out to be seen by the people throughout the land, it is a gratification to find among our visitors so many tourists, not only from various parts of Ireland, but also from Scotland, and these with the large contingents which now arrive every year from the western counties of England by way of the Isle of Man, swell our numbers of average daily admissions.

Under the existing system of administration four institutions, namely, the Museum, National Library, Botanic Gardens, and School of Art, whose functions necessarily overlap in some important respects, are linked together, and so far co-operate for mutual advantage. The books in the Library are available to those working the other three institutions, and the specimens in the Museum and Botanic Gardens are available to the students of the School of Art, while the official administrative staff is common to all.

The annual Parliamentary vote for the four institutions amounts to about £20,000, besides the vote taken by the Board of Works for maintenance. This expenditure may be regarded as a moderate outlay upon the part of the State, considering that an average of 2,600 persons visit these institutions daily, when all are open together.

I have thus conducted you through, or rather past, the controversies and labours which have resulted in the present condition of affairs; and I venture to hope that your inspection of the Museum and the other institutions during the next few days will prove a sufficient reward for your trouble in coming here, and that some of you, at least, will derive permanent advantages, carry away new ideas and also, and not least, pleasant recollections of this the first visit of the Museums' Association to Ireland.

III.

Recent Progress in Our Knowledge of Earthworms and their Allies.

THE present paper is intended rather to appeal to those who desire to be abreast of the latest information concerning a group of worms already provided with a voluminous literature, than to aim at a popular exposition of a subject hardly, perhaps, suited for such treatment. For some reason or other, the Oligochæta in general were, until a few years ago, perhaps, the least known group of any among the invertebrates; and yet they are particularly suited for investigation, and for many reasons. They are abundant, easily found, and easy to manipulate by dissection or with the microtome. Immense efforts are made yearly, at a large cost, to bring back a few skins and horns which are intrinsically as a rule of no interest at all, or of the very smallest importance. An infinitesimal fraction of the necessary expense incurred in the shooting and preservation of such material would supply many workers with abundant matter for study if devoted to the collecting and proper preservation of terrestrial and fresh-water invertebrates. To some extent this is now being done; and in the particular group upon which I report here, several collections of some importance have recently been made. Through the liberality of the Government Grant Committee of the Royal Society, I was able to secure the assistance of Mr. F. Finn to make collections in Zanzibar and Mombasa; more recently still, the Hamburg Museum sent out Dr. Michaelsen to South America, with the result that a very large collection of Oligochæta were brought home by him, and most kindly entrusted to me for study. Besides, the attention of naturalists travelling abroad with other aims has been successfully directed to the importance of this group; and in consequence a good deal of material has dribbled in to various Museums and individuals. Judging from the work of the last two or three years, which I shall endeavour to summarise here, we appear to be fairly advanced at the present moment in our knowledge of the main structural features of the group, at any rate of the terrestrial forms; the aquatic Oligochæta have been less collected, and are in a backward state so far as information goes. I shall now try to make a

connected story of recent progress, which will at least serve as a clue through the very widely scattered literature of the past year or two.

A good deal of attention has been paid to the phenomena of the distribution of these creatures, which are so important to the student of that branch of Biology. Apart from the notices of the occurrence of new species the most recent summary of that side of the study of the Oligochæta is to be found in no. 1. The difficulty which besets every person who attempts to philosophise upon the facts of distribution is to disentangle the really indigenous from the newly imported fauna. With earthworms this is apparently easier than with many groups. One may fairly speak of a "Holarctic" region embracing, of course, Europe, Northern Asia, and North America. The most prevalent genus is the common earthworm of this country (really consisting of many species), *Lumbricus*. There are somewhere about sixty species of this genus, considered *sensu lato* to include the very closely allied *Allolobophora* and *Allurus*. Nearly all of these are common to the Old and the New World; or, rather, but few of the *Lumbricus* of America are different from those of Europe. Now it is probable, in spite of the fact that this genus occurs most abundantly in gatherings from almost every other part of the world, tropics as well as the southern temperate latitudes, that the northern region is its true home. Two principal facts support this contention, which are as follows. The genus is most abundant in cultivated ground near the coast in the extra-Holarctic parts of the world; and, secondly, the species found are invariably identical with those of the northern temperate zone; the true indigenous earthworm fauna of South America, for example, has, as a rule, to be sought for outside the towns and their immediate suburbs. Were the *Lumbricus* truly indigenous to these parts of the world, one would fairly expect to meet with species different to those of the north; but one does not. Removing, therefore, this genus from the indigenous fauna of any countries save those enumerated above, it is easy to map out the globe into regions which, on the whole, correspond with those of Mr. Sclater. The one possible addition that might be made from this point of view to his six regions is an Antarctic form; but as I have treated of that matter in a quite recent number of this Journal, I leave it aside. Earthworms possess less facilities for active migration than many animals; a land-connection seems to be nearly absolutely necessary to their wanderings. It is perhaps otherwise with the aquatic Oligochæta, which are often, in correspondence with this, widely scattered. Vejdovsky (15) and I myself (2) have found that the so-called cocoons of the small freshwater form *Æolosoma*, distinguished by the beautifully and variously-coloured oil drops in the skin, are really chitinous cysts into which the worm temporarily withdraws itself. This is an evident assistance to involuntary migration, and it seems possible that some of the supposed "species" of this genus which have been described from Africa and America are identical with European species. The formation of

these cysts, in fact, doubles the animal's chances of being conveyed to distant places; the cocoon is, of course, the other chance. The cocoons of earthworms, being larger and often buried at considerable depths in the soil, are not likely to be accidentally attached to the feet of migratory birds, which, moreover, frequently affect the margins of lakes and pools, where the smaller cocoons of the aquatic Oligochæta would be very liable, one would imagine (there are no positive facts known to me), to be caught up and carried away. Another matter to be borne in mind is the more common occurrence here than among the earthworms of the escape of several young worms from one cocoon. The importation, therefore, of a solitary cocoon might serve to found quite a large colony in a new country. These are some of the facts and suggestions which arise from recent work upon the Oligochæta as regards the general phenomena of distribution.

But distribution has a bearing upon another branch of the subject which has received much attention—the classification of the group. The classification of the Oligochæta affords a literal instance of "Quot homines, tot sententiæ." The workers are, unfortunately, at present few, though this is mending, and everyone has his own individual scheme of arrangement; indeed, many of us have provided more than one scheme, though at fairly decent intervals. In attempting to decide upon the conflicting claims of different families to occupy a basal position in the series, it is reasonable to be influenced to a moderate extent by the facts of distribution. It is usually held that a wide and discontinuous range indicates an archaic form. Thus, for instance, *Peripatus* and the Tapir. Now, if we apply this to the earthworms it is perhaps the genus *Perichæta* which affords the most striking example. The genus has complete circles of setæ, from twenty to upwards of one hundred in number, according to the species, upon each segment of the body, and is found in Australia and India, Central America and the West Indies; it is feebly represented in tropical Africa and South America. The family Perichætidæ, may perhaps, be split up into four or five genera, but the differences are not great and there are gradations. The principal claim urged in favour of *Perichæta* as the most archaic existing form of earthworm was the condition of the excretory organs. In most text-books the typical Annelid excretory system is said to be a pair of tubes in each segment of the body, opening into the body-cavity by a ciliated funnel and on to the exterior by a pore. Researches, beginning with the year 1885, have shown that among earthworms a very large number of genera do not possess this arrangement at all. In *Perichæta*, for instance, that system is represented by a dense tufting of the body-walls and septa by innumerable coils of excretory tubes which open on to the exterior by innumerable pores scattered irregularly over the surface of the body. It has been stated by more than one naturalist that these nephridial tufts communicate from segment to segment, so that there can hardly be said to be any metamerism in an organ which in

so many Annelids is usually the most typically metameric. Bourne has, however, in his latest paper upon the earthworms of India, denied the connection from segment to segment. The matter is, therefore, still *sub judice*. From this diffuse and irregular network it has been held that the two pairs of separate nephridia per segment have been derived by reduction. Intermediate stages are offered by species with two and three separate pairs. This view of the origin of the nephridial system of the Oligochæta has, however, received a series of shocks at the hands of Vejdovsky (16), Bourne (10), and myself (3). We have all shown beyond any doubt that in the genera *Octochætus*, *Megascolides*, and *Perichæta*, genera in which the excretory system of the adult is constituted on the irregular, diffuse plan, the earliest appearance of this system is in the shape of a series of paired tubes, one pair to each segment. So far, therefore, *Perichæta* has no right to be regarded as a specially archaic form. It is, indeed, a matter of the greatest difficulty to adjust the rival claims of the existing families. More could doubtless be done if the exact relationships of the Oligochæta to other groups of "worms" could be definitely seen. In spite of the immense accumulation of anatomical detail during the last few years, but few facts which throw a light upon this most important question have been laid hold of. Something has been done to remove the barriers that were at one time supposed to divide the Oligochæta from the Leeches. The generally unpaired median male pores of the Eudrilidæ recall those of that group of Annelids; the continuity of the oviduct with the ovary is another character that removes one difference between the Leeches and the majority of the Eudrilidæ; finally, the same family of earthworms shows a considerable subdivision of the cœlom by the formation of sacs enclosing the spermathecæ and other parts of the generative apparatus; this is perhaps a foreshadowing of the almost obliterated cœlom, to speak with no great exaggeration, of the Leech. In two genera, viz., *Megascolides* and *Deinodrilus*, the dorsal vessel is enclosed in a sac forming a sort of pericardium, which is a step in the same direction. Even in histological details there are resemblances now known to exist which were formerly regarded as differences. Long ago Ratzel spoke of the leech-like muscular fibres of certain Oligochæta. The exact and beautiful researches of Cerfontaine (13) have proved that, in the common earthworm—and there is no doubt that the discovery applies to other Oligochæta—the muscular fibres consist of a softer granular core and of a radiately striate denser sheath which appears to be the exact counterpart of the muscular fibres of the Leech. This particular matter, however, takes us rather further. Quite recently Hesse (14) has pointed out that in the Enchytræidæ the muscles are more like those of a Nematode; he finds that, although there is apparently this ring of denser muscular substance surrounding a granular core, a gap exists in the said ring; through this split, often hardly recognisable owing to its fineness, the granular substance protrudes and is continuous with a large nucleated

cell. This accounts for the non-discovery of a nucleus within the muscular sheath of the fibre which was wanting to complete its likeness to the fibre of a Leech. A little more fanciful, perhaps, is my own comparison of the remarkable integumental network formed by the ducts of the paired nephridia, which ramifies through the body-wall of *Lybiodrilus* and more than one other Eudrilid, to the intra-integumental nephridial tubes of the Nematoidea; particularly to the coil of vessels which constitutes the Lemnisci of the Acanthocephala lately shown to exist in the true Nematoidea. In the Eudrilids in question the entire integument is riddled through and through with a complex system of tubes, all derived from the branching of the duct, by means of which the paired nephridia reach the exterior. There are, therefore, here as in *Perichæta* and some other forms, many external nephridial pores upon each segment of the body; but this same result is arrived at in a different way in the two cases. The most natural allies of the Oligochæta would seem to be the marine Polychæta; and yet recent researches have not tended to break down to any great extent the barriers separating these two groups. One character, however, hitherto held to differentiate the two has broken down. Cuvier called the Oligochæta as we now know them "Annélides abranches sétigères." In 1855, Grube described, unfortunately too insufficiently, a curious Annelid from the Nile which he called *Alma nilotica*; the same species has been lately re-discovered by Levinsen (12), who renamed it *Digitibranchus niloticus*. The worm has a series of tufted gills on the posterior segments. But it is not yet clear that the worm is not really a Polychæte. Apart from this dubious instance undoubted Oligochæta are now known to possess gills. Bourne was the first to discover this important fact; he found at Calcutta a Naid having a series of paired processes of the body-wall in the anterior segments. Later still I found in the "Victoria regia Tank" at the Botanical Gardens a worm allied to the common *Tubifex* of our streams and lakes with a series of dorsal and ventral gill-like processes upon the hinder segments; and more recently still (5) another Tubificid, belonging to a new genus *Hesperodrilus*, in which exactly the same kind of gills are present but lateral in position. Beyond these instances no Oligochæte has been discovered which places the Oligochæta nearer to the Polychæta than they were at the time when Claparède wrote. The phylogenetic arrangement of the Oligochæta must, therefore, still remain the aim of future investigation. The difficulties which surround the solution of the problem are not so much due to missing links in the chain as the inability to decide at which end of the chain was the beginning. Recent discoveries have rendered it in some cases almost an impossibility to distinguish family from family by any salient characters.

We may turn now to matters of special anatomical interest not having so great a bearing upon the inter-relationships and phylogeny

of the group. First among recent publications stands the monumental work of Vejdovsky (15) upon the embryology of *Rhynchelmis* and *Lumbricus*. One of his most important results is a clearing up of the very complicated series of excretory organs which arise at different times in the embryo. The first organ which serves this purpose is a series of tubes excavated in the interior of certain epiblast cells at the gastrula stage or even before; these cells are traversed by clear tubes which open behind into the primitive body cavity, *i.e.*, the space between the epiblast and the hypoblast. Next there is in some forms a pair of long tubes which open on to the exterior in the head region; these are the ciliated larval pronephridia, and they seem to be developed out of, or at least to have some connection with, the last-mentioned larval excretory cells. Quite independent of the last are the embryonal pronephridia; these organs are a series of paired tubes which open into the body-cavity by a "flame-cell." The flame-cell becomes a ciliated funnel, the nephridium grows, and we have the permanent nephridium of the adult. To give a thorough account of Vejdovsky's great book would take up more space than we can give; but one other point of some importance must be mentioned. He found that in the young *Lumbricus* the vascular system consists of a dorsal and of a ventral vessel which are connected by circum-intestinal vessels in each segment of the body; the dorsal vessel, as Vejdovsky himself was the first to discover a good many years ago, is at first double, a state of affairs which is permanently retained in a considerable number of earthworms throughout life. The connection of the dorsal and ventral vessels by a series of similar tubes in all the segments of the body is precisely what is met with in the simpler forms of Oligochæta such as the Tubificidæ. As still further tending to show that this is the primitive arrangement in worms which no longer show it, I may mention Bourne's discovery (11) that in *Paranais* the young buds have a full complement of these commissural vessels which are largely wanting in the adult.

Recent investigations into the anatomy of that very remarkable family the Eudrilidæ have progressed so considerably during the last few years, that from being one of the least known they have become quite one of the best known groups of Oligochæta. They have been referred to above as suggesting a link in the direction of the Hirudinea. Other points of interest have arisen. The most marked character of the family is the presence of large, usually unpaired, sacs which open on to the exterior and generally contain sperm. For this reason they have been called spermathecæ, though their anatomical structure is not precisely that of the spermathecæ of other earthworms. The investigations of Rosa (9) and myself (4) appear to have put beyond a doubt that these large sperm-holding sacs are derivatives of the septa which acquire an external pore; they can, therefore, have no morphological relationship to the spermathecæ of, say, *Lumbricus*, though an intimate physiological relation. But the interesting point

about these sacs is that we have a series of stages in the substitution of them for the true spermathecæ. In several genera of Eudrilidæ, *e.g.*, *Heliodrilus*, there is a single median spermatheca, apparently definitely corresponding to the true spermathecæ of other worms. This is wrapped in a sac which also communicates with the ovary by narrower passages. In *Hyperiodrilus*, the true spermatheca—in this case as in the last quite independent of the envolving sac—is greatly reduced in size. Finally, we have in the majority of Eudrilidæ no true spermatheca at all, unless the sac of mesoblastic origin opens on to the exterior by means of its exceedingly reduced representative. It seems clearly a case of the replacement of one organ by another physiologically similar, but morphologically distinct. The spermathecæ are the organs which receive the sperm during congress. It is, therefore, a most inexplicable fact that occasionally they open not only on to the exterior, but into the lumen of the gut. The fact was discovered a good many years ago in the Enchytræidæ, where it often occurs, by Michaelsen. I have found that in the North American genus *Sutroa*, first described by Eisen, exactly the same state of affairs unexpectedly exists. These facts may be commended to those who are still arduously labouring in the hope of finding gill-slits in some creature which is not a Chordate. The singular relationship between organs which would appear to have nothing in common, is enhanced in singularity by the fact that in an Eudrilid, *Paradrilus*, where the spermathecæ are of the mesoblastic type, precisely the same intercommunication is met with.

So much detailed research has been carried on of late by Benham, Horst, Rosa, Michaelsen, Eisen, myself, and others, that it is hard to compress into the limits of a short review like the present the results obtained. I confine myself, therefore, to such as are of a wider interest than to specialists. The last matter that I shall deal with, omitting a vast amount of rather less important though highly interesting work, is a curious case of change of function exhibited in the family Eudrilidæ, to which I have so often had occasion to refer. In this family, as in others, there are calciferous glands appended to the œsophagus, which secrete carbonate of lime. In Michaelsen's genus *Stuhlmannia*, and a good many of its more immediate allies, these glands are metamorphosed somewhat. They still open into the gut, but the lumen is greatly reduced, and does not by any manner of means extend through the entire gland. The gland is, in the main, solid, being built up of densely-associated cells, looking like peritoneal cells; the whole mass is permeated by a rich network of blood-vessels, as in the typical calciferous glands. Here and there, however, the cells in question have assumed the appearance of columnar gland cells; and when this modification has occurred, it is the invariable rule that what looks like the lumen of a tubular gland is occupied by blood. If there were not this singular change, one might be inclined merely to comment upon the fact that the glands, instead of being

formed of a much-folded membrane, had, as it were, melted into a solid ball. But the peculiar relation of the cells to blood-vessels seems to suggest a changed function, connected rather with the vascular system than with the alimentary. The whole matter is one of great interest, but would need for its proper discussion some space, which could not be fairly occupied by an article professing only to give a sketch of some of the more important recent advances in our knowledge of the structure of the Oligochæta.

The bibliography which follows is, of course, not exhaustive of the last two years; I have merely quoted those papers to which I have especially referred.

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F. E. BEDDARD.

IV.

Nearctic or Sonoran?

DR. A. RUSSEL WALLACE'S article on the mammals and birds of the Palæarctic and Nearctic Regions in last month's issue of NATURAL SCIENCE,[1] will have been read with the greatest interest by all students of the geographical distribution of animals. The tables of genera common to the two regions, or peculiar to one of them, seem to tell strongly in favour of retaining those convenient divisions of Dr. Sclater, which, by means of Dr. Wallace's own classical work on distribution, have become household words among naturalists all over the world. Yet I venture to believe that the facts may be so read as to support another view of the zoological regions of the ex-tropical continents.

The only alternative to the retention of the Palæarctic and Nearctic Regions of Sclater which Dr. Wallace mentions is their union into a single Holarctic Realm, as suggested by Dr. Heilprin in his work on the "Distribution of Animals."[2] But in a recent memoir on North American mammals[3] (already referred to in NATURAL SCIENCE[4]), Dr. C. Hart Merriam advocates a different and more natural view. He would unite only the "Boreal" part of Sclater's Nearctic Region with the Palæarctic, leaving the rest as a separate region, to which he applies Professor Cope's term "Sonoran." This Sonoran Region he considers no mere borderland between the Northern and Neotropical realms, but a primary division characterised by the presence of the most distinctive North American mammals.

The Boreal division of Dr. Merriam roughly agrees with the Canadian sub-region of Dr. Wallace's "Geographical Distribution of Animals." He maps it, however, as extending southward along the three great mountain systems of North America—the Alleghanies, Rockies, and Sierra Nevada, in parts as a continuous tract, elsewhere in isolated patches, some of which reach as far south as Arizona, California, and Carolina. As might be expected, however, there is no decided line separating the northern and Sonoran regions; a

[1] Vol. iv., p. 433.
[2] London, 1887 (Int. Sci. Series).
[3] *Proc. Biol Soc. Washington*, vol. vii., 1892, p. 1.
[4] Vol. iii., p. 288.

"transition" zone is shown on the map, which in places attains a breadth of over 300 miles, wherein the two faunas overlap. This zone is mostly confined to the northern and mountain districts of the United States, but it invades the British territories to the west of Lake Winnipeg, to the north of Lakes Erie and Ontario, along the southern bank of the St. Lawrence, and again in Nova Scotia.

If we now examine the distribution of the seventy genera of mammals given by Dr. Wallace as inhabiting the Nearctic Region, we find that only eight *Canis*, *Otaria*, *Bos*, *Sciurus*, *Sciuropterus*, *Spermophilus*, *Hesperomys*, and *Lepus* can be fairly regarded as ranging indiscriminately over the Boreal and Sonoran districts. Of these only one, *Hesperomys* (the Vesper Mice), is peculiar to America, and, on referring to Flower and Lydekker's "Mammalia," it appears that this should be included in the Old World genus *Cricetus*. The Sea-Lions (*Otaria*), though not Palæarctic, occur in other Old World Regions.

All other genera of North American mammals can be referred to either the northern or Sonoran fauna, even though some of them overstep the limits of the transition zone.

The Boreal fauna of Dr. Merriam comprises thirty of Dr. Wallace's genera[5] — *Sorex*, **Neosorex*, *Urotrichus*, **Condylura*, *Ursus*, *Lutra*, **Latax*, *Mustela*, *Gulo*, *Trichechus*, *Phoca*, *Cystophora*, *Cervus*, *Rangifer*, *Alces*, *Ovis*, **Haplocerus*, **Ovibos*, *Tamias*, *Arctomys*, *Castor*, **Haploodon*, *Arvicola*, *Myodes*, *Cuniculus*, **Phenacomys*, **Fiber*, **Zapus*, **Erethizon*, and *Lagomys*, of which only the ten marked by an asterisk are peculiarly American. Of the remaining twenty, all but six: *Ursus*, *Lutra*, *Mustela*, *Cervus*, *Ovis*, and *Arvicola* are only elsewhere to be found in the Palæarctic Region, while, even of these six, *Ursus*, *Ovis*, and *Arvicola* are characteristic northern genera, which can only be regarded as incursors in the tropical regions where they occur. These facts seem to point strongly to the affinity of the northern faunas of the Old and New Worlds, and to require the union of Boreal American with the Palæarctic Region of Sclater. It will be possibly urged as an objection that Boreal America is admitted to be the home of ten distinctively American genera. But if the relationships of these be examined, it will be found that only two, *Condylura* and *Erethizon*, are American in their affinities. The nearest relations of all the rest must be sought in the Old World. And *Condylura* and *Erethizon*, though confined to the Boreal *Region*, should be regarded as belonging to the Sonoran *fauna*.

If the genera of mammals already enumerated be compared with Dr. Wallace's lists, it will be seen there are thirty-two remaining, which are fairly reckoned by Dr. Merriam as distinctively Sonoran, although nine of them range into the southern parts of the Boreal division. Of these thirty-two, only five, *Plecotus*, *Vesperugo*, *Vespertilio*,

[5] The genera adopted by Dr. Merriam are more favourable to his views than those given by Dr. Wallace. I take, however, the latter as the basis for comparison.

Nyctinomus, and *Felis* occur also in the Palæarctic Region. The remaining twenty-seven are peculiarly American, and it will be seen that this number is just over two-thirds of the thirty-nine given in the third column of Dr. Wallace's table as the number of Nearctic genera not to be found in the Old World. The peculiar family of the Pouched Rats (Geomyidæ) is specially noteworthy as coming distinctly into the Sonoran fauna, only one of its genera (*Thomomys*) just entering the Boreal Region. The other peculiar mammalian family, Antilocapridæ (Prong-horn), is also seen to be typically Sonoran. The differences between the two mammalian faunas in North America may now be shown in tabular form :—

	Distinctively American.	Common to America and Palæarctic Region.
Genera common to Boreal and Sonoran Regions ..	2[6]	6
„ typically Boreal ..	10	20
„ „ Sonoran ..	27	5

And it becomes clear that the affinities of the northern fauna of America are with the fauna of Europe and temperate Asia, while the Sonoran fauna is exceedingly distinct.

When we turn to the birds we find, as might be expected, that the regional divisions are not so closely kept as by the mammals. Nevertheless it is possible, by a survey of the distribution of each genus, to determine to which fauna it belongs. A genus with several Sonoran species and but one Boreal may fairly be reckoned as Sonoran. In compiling the following summary I have taken the distribution as given in the A.O.U. Check List, whence Dr. Wallace compiled his genera :—

	Distinctively American.	Common to America and Palæarctic Region.
Genera common to Boreal and Sonoran	30	32
Typical Boreal genera ..	2[7]	14[8]
„ Sonoran „ ..	81[9]	8[10]

It is not necessary to give lists of all these genera. I give in the footnote their reference numbers in Dr. Wallace's lists, which will enable anyone interested in the subject to check my results.

It will be seen that of the hundred and thirteen genera of birds which, according to Dr. Wallace, differentiate the Nearctic from the

[6] One of these (*Otaria*) is not *peculiarly* American.

[7] Genera nos. 34, 35 (3rd col.).

[8] „ „ 18, 20, 21, 22, 23, 25, 26, 27, 31, 36, 37, 47, 53, 54 (2nd col.).

[9] „ „ 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 23, 26, 28, 32, 33, 37, 41, 42, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 59, 61, 62, 63, 64, 65, 66, 67, 68, 70, 71, 72, 74, 75, 77, 78, 79, 80, 81, 82, 83, 85, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 102, 103, 104, 105, 106, 107, 108, 109, 111, 113 (3rd col.).

[10] „ „ 6, 7, 8, 29, 33, 41, 49, 52 (2nd col.).

The sixty-two genera not enumerated here are common to the Boreal and Sonoran tracts.

Palæarctic Region, eighty-one, or over 70 per cent., are typically Sonoran, while only two are typically Boreal. That as many as thirty genera should range over the whole continent may be urged in support of the retention of the Nearctic Region intact. Yet many undoubtedly Neotropical genera range into the Sonoran; and when we consider the great extent of the North American continent and the absence of any natural barrier to check migration from south to north, our surprise should be that the mixing of the two faunas has not been more complete.

The second column of the summary given above yields highly suggestive facts. With the single exception of *Astur*, all the fourteen typical Boreal genera common to North America and the Palæarctic Region are confined to the latter region in the Old World. This shows most strongly the affinity between the Boreal American and Palæarctic bird faunas. On the other hand, we find that of the remaining forty genera in the second column, only three (*Acredula*, *Nyctala*, and *Archibuteo*) are, in the Old World, typically Palæarctic. The rest are either of very wide range, or occur in both the Palæarctic and Neotropical Regions.

Strong confirmation of the distinction between the Boreal and Sonoran faunas in America can be obtained from other groups. The paucity of Lizards in the former fauna has indeed been well shown by Dr. Wallace himself, as a survey of the tables of distribution of families in the second volume of his great work shows that but one genus of these reptiles enters his Canadian sub-region. This is *Gerrhonotus*, placed by Mr. Boulenger in the latest British Museum Catalogue in the Family Anguidæ. On looking through that Catalogue I find, on the other hand, that the Sonoran Region is characterised by no fewer than 22 genera of lizards: —*Eublepharis*, *Anolis*, **Dipsosaurus*, **Sauromalus*, **Crotaphytus*, **Petrosaurus*, **Callisaurus*, **Uma*, **Holbrookia*, *Uta*, *Sceloporus*, *Phrynosoma*, *Gerrhonotus*, *Ophisaurus*, **Anniella* (forming a peculiar family), *Heloderma*, **Xantusia*, **Cnemidophorus*, *Chirotes*, **Rhineura*, *Lygosoma*, and *Eumeces*, of which the 11 marked with an asterisk are not found elsewhere. The genera which are not peculiar have either Neotropical affinities or are represented in corresponding latitudes in the Old World. The Tortoises tell the same story. A survey of the land and fresh-water genera of Chelonians, as given in Mr. Boulenger's British Museum Catalogue, shows that only two genera, *Trionyx* and *Emys*, neither peculiar to America, reach the Boreal[11] district, while the Sonoran, in addition to these, possesses *Chelydra*, *Macroclemmys*, *Cinosternum*, *Chrysemmys*, **Malacoclemmys*, *Clemmys*, **Cistudo*, and *Testudo*, the two distinguished by the asterisk being peculiar. The Sonoran Region is further to be distinguished by the genus *Alligator*, among the Crocodiles.

[11] The former, indeed, seems not to pass Dr. Merriam's transition zone.

While admitting the great convenience of the Six Regions of Dr. Sclater, it seems that the above-mentioned facts yield strong support to the suggested revision of their boundaries. The addition of the Boreal tract of North America to the Palæarctic Region will render that great division of the earth's surface more natural than it is at present, as the elements of the Northern American fauna are seen to be chiefly Palæarctic in their affinities. To this great realm Dr. Heilprin's name of Holarctic might be applied, or it might perhaps be better known as the Great Northern Region. I need hardly remind students of Geographical Distribution that such a region was mapped thirty years ago in Murray's work[12] on Mammalian Distribution. The Sonoran Region will, indeed, be somewhat less rich than the old Nearctic in peculiar forms of life, but it will retain its most distinctive characteristics and comprise a more natural fauna than did the larger tract. The objection to the new arrangement, which I cannot but feel to be considerable, is that, even outside the broad transition tract of Dr. Merriam, overlapping of the two faunas takes place, especially in the extension of peculiarly American birds to the Arctic Ocean. Still, I cannot think that this overlapping should deter us from adopting the more natural division. No zoological region can be mapped with the hard and fast line of a political frontier, and the zoologist must always think more of faunas than of geographical boundaries. That two distinct faunas exist in North America seems abundantly clear, although the nature of the country has allowed considerable overlapping. It is well to remember that in parts of the Mediterranean sub-region there is a decided Ethiopian colouring to the fauna, in spite of the barrier of the Sahara. Were Africa without that barrier to the northern spread of Ethiopian forms, we should have such a mingling of two faunas as would necessitate a wide transition tract on our own side of the Atlantic.

GEO. H. CARPENTER.

[12] The "Geographical Distribution of Mammals." By A. Murray. London, 1866.

SOME NEW BOOKS.

The Art of Stuffing.

Scientific Taxidermy for Museums (based on a study of the United States Government collections). By R. W. Shufeldt, M.D. Smithsonian Institution. Report of the U.S. National Museum for 1892, pp. 369–436, pls. xv.–xcvi. Washington, 1894.

It was the Rev. J. G. Wood who once said that his earliest attempt at stuffing an animal was made upon a mouse. After skinning the creature, he cut off so many inches of his school ruler as would fill up the interior, and stitching together the margins of the skin under the belly, found a satisfaction in contemplating the success of his creation. The old days of monstrosities are rapidly fading away in all the larger institutions, and especially in our own British Museum of Natural History. No longer do we there see those highly polished cattle in whose sides, rumour has it, it was quite possible to get enough reflection to arrange one's hair; and we may even discount the statement of certain evilly-disposed persons who affirm that within recent years there was to be seen one animal in the British Gallery whose flanks had been repaired by a process of skin grafting of a somewhat unsuccessful nature. The very beautiful examples of individual stuffed animals, or groups of animals, which are fast displacing their old and worn representatives in our National Museum are too well-known to need recalling here, and Dr. Shufeldt refers to them as "Perhaps some of the finest groups in the world." Two of the best of these groups (of birds) Dr. Shufeldt has been able to reproduce through the courtesy of Dr. Bowdler Sharpe, and in doing so he pays a high compliment to "that distinguished ornithologist's" interesting paper on these stuffed groups which appeared in the *English Illustrated Magazine* for December, 1887.

In an exceedingly interesting sketch of the history of taxidermic art, prefixed to the paper, Dr. Shufeldt reminds us of Hanno's discovery of the gorilla five centuries before Christ. These were flayed, and the skins taken to Carthage, where they were preserved for many generations, and described by Pliny as Gorgones. He also refers to the robes of the Mexican kings, with their gorgeous ornamentations of trogon and other brilliantly plumaged birds; quotes Shakespeare's apothecary, within whose

> Needy shop a tortoise hung,
> An alligator stuffed, and other skins
> Of ill-shaped fishes,

and finally tells us that the earliest stuffed specimen, as opposed to a mere skin, now known to exist, is a rhinoceros still preserved in the Royal Museum of Vertebrates in Florence, and dating from the sixteenth century.

Dr. Shufeldt next discusses the methods employed by the best taxidermists of the century, and points out the advantages of a liberal education and the importance of a first-rate knowledge of general

biology and anatomy. The taxidermist should be, besides, a good field naturalist, a careful observer of nature and of the habits of animals, a botanist, a topographer, and an artist. The importance of photography is fully insisted upon, and Dr. Shufeldt considers a perfect knowledge of the art and practice of photography more useful perhaps than anything else. He says: "No taxidermist who has any regard for an attainment of excellence in his calling should neglect to make good photographs of all the living animals that he can, and that upon every possible opportunity. This should not be confined to wild animals alone, but to all the domestic ones in their most common attitudes."

Passing on to the true object of his paper, the criticism and explanation of stuffed or modelled specimens of natural history objects, Dr. Shufeldt refers to the beautiful gelatine casts, taken from plaster moulds, of the octopus, squid, and other soft-bodied invertebrates, shown at the Chicago Exposition, photographs of which he reproduces in support of his words. Noting the difficulties of the proper preservation of fishes, he mentions the remarkable collection of preserved fish in the Government Museum at Madras, which Hornaday referred to as the finest of its kind in existence. The lamentable aspect of fishes in alcohol and the further distortion produced by the jars in which they are usually preserved is noted. The advantage of making plaster casts, properly coloured, is insisted upon, and emphasised by photographs of some beautiful examples in the U.S. National Museum. The "Buckland" fishes will be remembered by most readers of this article, and the successful preparations made by Mr. Montagu Browne in more recent years. In our own Museum at South Kensington, we see an attempt to replace the ordinary museum fish with some more lifelike stuffed examples, but the use of plaster or the Browne methods might be more largely employed to advantage in both the Zoological and Geological Galleries. Dr. Shufeldt says, speaking of rays, that the plaster and gelatine methods are so successful with these fish that, properly coloured, it would be difficult to distinguish between photographs of the living fish, the plaster, and the gelatine cast, if they were all taken on the same scale and under the same conditions. In all his statements, too, the reproduction of photographs of fish-models fully bear him out.

Some half-dozen photographs of beautiful plaster casts of snakes are reproduced, of which the rattlesnake, in a hole in the rocks, is wonderfully true to nature. Indeed, in these animals it is difficult to see why anything else but plaster casts of excellence should be shown in public galleries, so true is the cast, and so difficult is it to properly stuff the creature itself. The reproductions of photographs of stuffed birds have by far the largest space allotted to them, and they form an exceedingly interesting collection. Examples are given of correctly and incorrectly stuffed auks, gulls and penguins, of a scolding parrot, a parrot on the defensive, of game cocks and hens, a pigeon preening the breast feathers, a quail elevating feathers prior to shaking, and also in the act of walking, of owls, and various groups of birds, including, as before mentioned, some in our own Museum, of rare excellence.

In the Mammalia, examples are given of kangaroo properly and improperly stuffed, a group of armadillioes, a porpoise, gazelles, a group of *Bison americanus*, the head of a zebra of remarkable excellence, jack rabbit, head of a tiger, and many more which we are unable to refer to.

In writing this paper, which we specially commend to the notice of the Museums' Association which meets this month at Dublin, Dr. Shufeldt has earned the gratitude of every true student of nature, he has done the taxidermist an incalculable service in elevating his work from that of a mere stuffer to that of an artist, and there is no doubt he will see his closing words realised in "the further encouragement and stimulation of the progress of the art of taxidermy."

MORE EXTINCT MONSTERS.

CREATURES OF OTHER DAYS. By the Rev. H. N. Hutchinson. 8vo. Pp. xxiv., 270 (illustrated). London: Chapman & Hall, 1894. Price 14s.

IN a previous issue we had the pleasure of noticing Mr. Hutchinson's first literary and pictorial attempt at the restoration of extinct animals, and then expressed the hope that the work in question would soon reach a second edition. Not only has this hope been realised, but "Extinct Monsters," as the first volume was entitled, has been so successful from a publishers' point of view that it is now followed by another work of a similar nature. While carefully avoiding all mention of invertebrates in this new venture, the author takes into consideration several groups, such as the fishes of the Old Red Sandstone, the primeval salamanders, and the anomodont reptiles, which were altogether passed over in "Extinct Monsters"; while the treatment of many of the groups noticed in the latter is expanded and amplified. That Mr. Hutchinson has produced a book which forms a worthy companion to his first effort, we are fully assured, and we can only hope that it may obtain as much appreciation from the general public as seems (deservedly) to have fallen to the share of the latter. So far as the illustrations are concerned, we think that the book is almost beyond praise, and we notice that in his restorations of the dinosaurs the artist has considerably improved on his former efforts. Much interest will undoubtedly attach to the figures of the primeval salamanders or labyrinthodonts, as well as to that of the strange and gigantic pariasaur from South Africa. We have too long been accustomed in text-books to see labyrinthodonts restored in the form of impossible frog-like monsters; and it is refreshing to find them now in a guise somewhat near to what was probably their living form. The restoration of pariasaur strikes us as particularly successful, but may we ask the author why, on page 81, he transliterates the name of this creature as *Poreiasaurus*, while, on the preceding page, we find a name which has a similar diphthong in the original spelt *Tapinocephalus*? We may also suggest that he is not quite up-to-date in his treatment of the anomodonts and their allies, among other errors including *Proterosaurus* in that group, whereas it has been pretty conclusively shown to be a rhynchocephalian. Indeed, one of the chief faults we have to find is that the author, both in classification, nomenclature, and anatomy, follows one or two palæontologists to the exclusion of others.

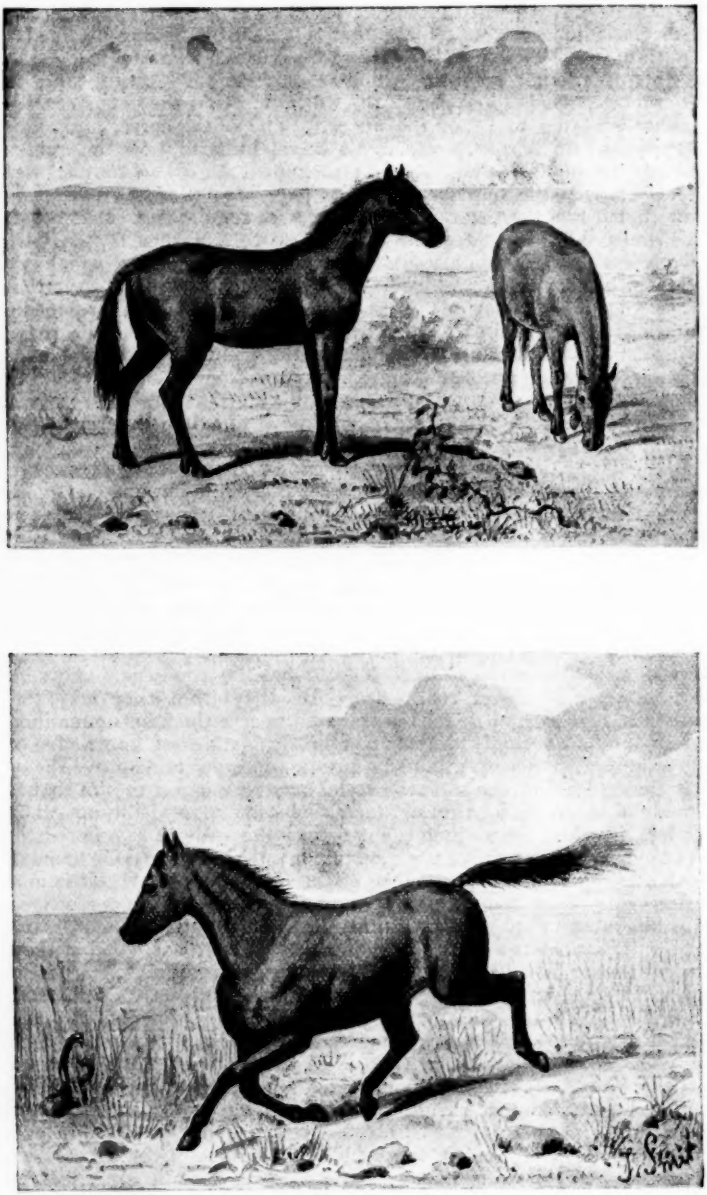
On the whole, the book is written in a pleasant and agreeable style, although sometimes, as in the first paragraph on page 241, some of the sentences appear to have no relation to those which precede them, while in other cases the style is not free from grammatical faults. Perhaps the author will have the goodness in a second edition to inform us whether the sentence on page 107, stating that "like the gavials of India, they [Liassic and Oolitic Crocodiles] doubtless swarmed in the rivers and lakes, and preyed on the fishes that lived in the seas of those periods," is to be attributed to such a slip in grammar, or whether he possesses a

knowledge of the former distribution of Indian gavials which is denied to humble individuals like ourselves. Two pages later, we meet with the astounding statement that a "genus probably attained a length of ten or twelve feet." May we ask how you measure a genus, as this is another point in which we confess to a pitiful state of ignorance? Again, on page 212, we notice that the genus *Paloplotherium* is stated to be on the ancestral line of the horse, and to be very similar to *Hyracotherium*. We have, hitherto, been misguided enough to believe that the animal known as *Paloplotherium* was identical with the one mentioned on page 180 as *Palæotherium minus*, and that it had nothing on earth to do with the descent of the horse. We must, however, presume that the learned author is here also enabled to correct by his knowledge the ignorance in which we have hitherto been enveloped. The statement on page 112, that these and other creatures "are all nearly related to a previously known but larger animal, called by Cuvier *Lophiodon*," likewise reads to us somewhat curiously, seeing that the genus *Lophiodon* includes about a score of species, ranging in size from a sheep to a big rhinoceros.

Although the limited state of our knowledge, in comparison with that apparently possessed by the author, precludes our criticising such statements with the authority which is desirable, we are not hampered by any such disabilities when we point out manifest contradictions in the book. Turning, for instance, to page 130, we read that, "it has sometimes been asserted that birds were derived from dinosaurs in the course of evolution, but this is not a correct statement of the views of leading naturalists such as Professor Huxley"; but a little later (pp. 151, 152) it is written that "we have already alluded to Professor Huxley's theory that birds are descended from dinosaurs." This is unkind, as it would have been a source of great gratification to us to have learnt what the professor's views on this interesting subject really are. Be they what they may, the author is, however, by no means prepared to give them his unqualified assent, and accordingly draws upon his own stores of knowledge of the anatomy of the two groups in question in order to disprove them.

Before leaving the author's style, may we suggest to him that it would be much less irritating to ourselves, and probably to other readers, if, when mentioning the names of the authorities referred to, he would refrain from appending certain mystic letters to their names? Such additions only spoil the look of the text, and, although it is just conceivable that it may gratify a small percentage of the personages thus honoured to see such additions to their names, to the ordinary reader it is a matter of the most supreme indifference whether they are entitled to be called F.G.S., F.R.S., L.C.C., or P.C.L.P. (parish councillor for Little Pedlington!); and on this subject we commend Lowell's "Note to Title-page" of the "Biglow Papers" to the author's notice. We cannot, moreover, pass over the statement on page 18, to the effect that in England "so little is done for the cause of science by our rulers." In the first place, in this democratic age it is not "our rulers" but ourselves who are responsible for the amount spent on science; and, secondly, in our own opinion, considering the very small percentage of the population that takes an interest in Zoological Science, quite sufficient money is expended by Government thereon. Personally, as a taxpayer, the writer would be most unwilling to contribute a single farthing more towards such a subsidy.

Reverting for a moment to the Labyrinthodonts, we confess that



THE HIPPARION (UPPER PICTURE), AND A RECENT WILD HORSE (LOWER PICTURE). (From *Creatures of Other Days.*)

RESTORATION OF THE DINOTHERIUM. MIOCENE PERIOD. (From *Creatures of Other Days.*)

we are somewhat puzzled by the statement on page 13 that in the figure of the tracks on the opposite page only one-half of the track of the animal is delineated. Surely, as the impressions are both right and left they must include those of the feet of both sides; if not, will the author kindly explain his views more fully?

The restorations of the mammals are for the most part well done, and they are probably as near like the originals as we are ever likely to approximate, although it is probable that even the artist himself would be willing to admit that the indications of colouring, which have in some cases been attempted, are more or less fanciful. It is, moreover, a little misleading to find pig-like creatures included in the chapter entitled "Tapir-like Animals, etc." That the book will attract a large number of readers, we have little doubt, and we cannot do more than wish it a success similar to that which has attended its predecessor.

The Cult of the Camel.

THE CAMEL: ITS USES AND MANAGEMENT. By Major A. G. Leonard. 8vo. Pp. ix. and 335. London: Longmans & Green, 1894. Price 21s.

IT is a well-known fact that during the last Cabul war and the Nile Expedition the loss of camels through overwork, improper or scanty feeding, and bad treatment, was almost appalling; and although a considerable proportion of this loss was inevitable, there is little doubt that the number of casualties might have been enormously reduced by the bestowal of more attention on the needs and habits of the animals in question. As wars in the same regions or other districts where camels can be employed are inevitable in the future, we heartily welcome Major Leonard's attempt to give Tommy Atkins and his superiors some insight into the habits and needs of these invaluable although unsociable creatures. As the author was both present during the Afghan war and accompanied the Camel Corps during the march to Korti, where he appears to have been connected with the commissariat department, his opportunities of observing the camel at work have been unrivalled; and that good use has been made of such opportunities, the present work affords ample proof. In the book before us we have chapters on the characteristics and temperament, and the instinct and intelligence, of camels, as well as others on their breeding, watering, feeding, loading, management, and ailments, and further one on their capacity and endurance. For the most part, these are well written, and ought to show any intelligent officer how to make the best use of these animals when put under his charge. We notice that, although the stupidity of the camel is admitted, Major Leonard does not give the camel such a bad character in general as is attributed to it by Palgrave and others; and he is doubless right in his assertion that much of the moroseness of its disposition is due to bad treatment and mismanagement. Attention may also be directed to the author's observations on the importance of watering camels at stated intervals whenever practicable, since there is no doubt that during the wars alluded to above a large proportion of the deaths were due to the mistaken belief that these animals are capable of going for an almost unlimited period without water.

If the author had confined his attention to the camel as a beast of burden, we should have had nothing but commendation for his book; but he has unfortunately thought it necessary to say something of the geological and zoological history of the creature, and in the course of his observations renders the statement in the introduction that he is

not a naturalist altogether superfluous. It strikes us, for instance, as somewhat curious to find (p. 1) the camel referred to as one of the oldest living mammals, while a few lines further on it is stated that its prehistoric ancestors are unknown. The context shows that this statement is due to Andrew Murray's belief in the close alliance between the Siwalik and modern camels; but if the author had consulted authorities on the subject he would have found that they are very different, and his confusion between a species and a genus is too obvious to need pointing out. When, moreover, the author (p. 2) states that "it is a curious fact that the former description [? distribution] of the family seems to be much wider than the natural habitat of the forms now extant—a fact which may, perhaps, be attributed to the Deluge, and the sundering of what in those days were vast globes into smaller and insulated continents," he is not only a bit behind the times, but likewise most remarkably enigmatical. Still more startling is the assertion on the same page—made on the authority of a South African friend who has *compared the figures* —that the *Helladotherium* of Pikermi, instead of being, as we have all supposed, a near cousin of the giraffe, is nothing more than a camel! What will our friend Dr. Forsyth Major think of this as the result of all his labours to instruct the public? Other instances of misconception and error might be referred to, but we can only call attention to the assertion, on p. 22, that a camel has twelve molars on each side of the upper jaw, and ten in the lower, as a sample of the anatomical blunders disfiguring what is otherwise an excellent work.

Blind Crustacea.

The Subterranean Crustacea of New Zealand: with some general remarks on the Fauna of Caves and Wells. By Charles Chilton, M.A., D.Sc. *Trans. Linnean Soc. London*, ser. 2, Zoology, vol. vi., pt. 2, May, 1894.

This paper treats of the curious blind crustacea which inhabit the underground waters of the Canterbury Plains in the South Island of New Zealand. The author leads off with an historical account of previous writings on the subject, and gives a fuller bibliography at the end of his paper. Detailed descriptions of the six New Zealand forms follow, and the author then passes to the more general considerations which we present as interesting to the majority of readers. One of the characteristics of these underground crustacea is the absence of colouration. The integument and greater part of the body is colourless, and though traces of colour (pink or yellow) are occasionally observed, this is the result of the yolk of the egg in females, the liver tubes, or the red colour of the fluid in the vascular system (in worms). In comparing these subterranean forms with deep-water organisms which often show a more or less definite colouration, the author is inclined to believe that the difference in colour is due to some differences of chemical composition rather than to the presence or absence of light. Professor S. I. Smith has previously stated that the darkness existing beneath 2,000 fathoms of water is very different from that existing in ordinary underground caverns.

With regard to eyesight, Mr. Chilton observes that in the New Zealand specimens he has been unable to find any external trace of eyes except in one species, *Crangonyx compactus*, in which the eye is represented by two or three imperfect lenses apparently quite without pigment. He has as yet had no opportunity of making sections to study the conditions of the optic lobes and nerves. On the whole, too, the New Zealand forms give only a modified support to the conclusion

that the subterranean species are more abundantly supplied with sense-organs (other than eyes) than allied surface animals. He is unable to add any fresh information as to the food and food-supply of these crustacea. With regard to arrested development previously noticed among these animals, Mr. Chilton says he has a good example in *Cruregens fontanus*, which has the seventh segment of the peræon small and without appendages, as is the case in the young forms of many Isopods. Of the habits of *Cruregens*, he notes that "they ran backward and forward with equal rapidity, and did not seem particular which way they went; they did not swim, and if they dropped off a plant wriggled helplessly till they reached the bottom." They ran against objects in a way which seemed to indicate that they were totally blind, and he occasionally saw two approach very near each other, apparently without being aware of it, and then suddenly jump apart when they touched.

Speaking of the age of the cave fauna of New Zealand in particular, the author notes that all the places where subterranean forms are found are marked on Professor Haast's map as either "post-Pliocene alluvium" or "recent alluvium" and mostly in the latter, and he suggests that it is quite possible, if thorough search were to be made, that some species of the genera (especially of *Phreatoicus*) would still be found inhabiting fresh-water streams among the Southern Alps of the country. The paper is well illustrated by some quarto plates, and is a valuable contribution to a most interesting subject.

A Criticism and a Theory.

GESTALTUNG UND VERERBUNG. Eine Entwickelungsmechanik der Organismen. By Dr. Wilhelm Haacke. Pp. 337, twenty-six illustrations in the text. Leipzig: T. O. Weigel Nachfolger, 1893. Price 8 marks.

ALTHOUGH Dr. Haacke does not proceed to the display of his own theory until he has spent over one hundred pages in criticising the theories of others, and specially the theory of Weismann, it may be more convenient to attempt at once to give an account of this new panacea for all biological difficulties. His theory is *epigenetic* in the strictest sense. He believes that the plasma of the whole body of each animal and the plasma of the germ-cells are of the same kind. Hence he thinks that the shape and symmetry of the adult must be explained by the shape and symmetry of the elements in the plasma of the germ-cell from which the adult grew. The plasma is made up of ultimate elements, which Dr. Haacke terms "*gemmæ*." These are rhombic prisms, and the process of assimilation consists of the formation of new *gemmæ*. The unformed food of the plasma is built up into the peculiar *gemmæ* of the particular animal, or plant, in some such fashion as inorganic particles grow into crystals under the stimulus of the presence of crystals of their own order. *Gemmæ*, by the adhesion of their faces, are built up into units of a higher order, called *gemmaria*. As out of one set of similar bricks many different castles, depending on the number and arrangement of the bricks in each castle, might be formed, so out of a comparatively small variety of *gemmæ* an indefinite number of *gemmaria* might be obtained. It is these *gemmaria* that are the real morphological units. Out of one *gemmarium* you could tell the whole animal. But as from their size, if from no other reason, the investigator is exceedingly unlikely ever to see the *gemmarium*, Dr. Haacke goes to work the other way about, and endeavours to deduce, from the shape of adult organisms, the shape of their *gemmaria*. This he does in a sufficiently

ingenious manner, and at least succeeds in convincing the reader that the shapes of animals are not altogether unprofitable subjects of study.

The architecture of the *gemmaria*, as one learns from Dr. Haacke's descriptions and figures, is of a simple kind. They form no airy structures with arches and beams and colonnades. The *gemmæ* are superimposed in solid masses as our primeval forefathers might have built monuments to their fathers, or altars to their gods. As there are different numbers of *gemmæ* in the successive tiers, they resemble still more closely the solid staircases which we, as children, formed of our wooden bricks.

These *gemmæ* may adhere together closely or loosely. In each generation individuals with *gemmaria* of which the *gemmæ* are closely adherent are very naturally more stable than those whose *gemmaria*, so to speak, dissolve with every puff of wind. This is Dr. Haacke's interpretation of differences in the strength of individual constitutions. He points out that, in the struggle between individuals, it is not the individual with a claw slightly longer, or with a tooth slightly sharper, that, on the average, survives longer to propagate his species more largely. It is the individual generally better endowed, generally more adapted to resist every blow of fate, to take advantage of good fortune of every kind, that is favoured in Nature's battle. Interpreted into his theory, this means that in each generation those individuals with little adhesion of the *gemmæ* in the *gemmaria* speedily are discomfited; that, in fact, there is a gradual phylogenetic strengthening of the stability of the *gemmaria*.

From this another result ensues. Strengthening of the *gemmaria* implies a resistance to change of any kind. Just as the stable *gemmaria* resist external influences that might be to their hurt, so they resist influences that might be to their advantage. Thus, with age each race becomes hardened. It pursues its own line of progress resisting all other influences, and so a race may die out, as many races seem to have died out, because it persists in a definite line of development after that line has ceased to be of advantage to it, and has even become detrimental.

The plasma, that is to say the *gemmaria*, all over the body of an animal is not only similar in shape and structure, but is in a condition of organic stability. Hence it follows that any external influence acting on a part of the organism, so as to alter the shape of the *gemmaria*, will disturb the equilibrium of the whole body. The disturbed system gradually settles into a new position of stability, a position in which the new force has been registered. Thus it happens that every change of any part of the organism is reflected upon the plasma of the germ-cells of the organism. Thus, acquired characters are inherited, subject, of course, to the limitation that the impacted force must be sufficiently great, or last through a space of time sufficiently long to counteract the stability of the *gemmaria* acquired in ages of elimination of the less stable. Thus, for instance, Dr. Haacke scoffs at the attempt of anyone in a few generations of mutilations, by docking the tails of even 90 generations of mice, to prove or disprove the question of the inheritance of acquired characters. When nature has been building up *gemmaria* that give rise to tails, and hardening these *gemmaria* for a million generations, it is ridiculous for man with his scalpel and his few score years to hope to interfere.

It may be possible that, to some readers, a theory so purely theoretical as this theory of Dr. Haacke's may not be attractive.

Even such we advise to peruse Dr. Haacke's book. For running through this warp of ingenious, but possibly perverse speculation is a woof of actual observation, of shrewd criticism and valuable suggestion. So far as we are concerned we do not think that this theory has the slightest merit even as a provisional hypothesis. We think it the purest moonshine, and regret that a man of Dr. Haacke's evident ability should have published it, even as a jest. This opinion notwithstanding, we think that there are very few pages in the book where a biologist will fail to find a novel handling of novel facts and a most suggestive and stimulating treatment of the most interesting questions of biology. There are among us many given to the translating of strange books. If the idea of translating this book occurs to anyone, we offer the following advice: Let him carefully eliminate every reference to the particular theory of the *gemmaria*; let him curtail a few of the pages of algebraic formulæ, and the volume, so trimmed and lightened, will prove as useful, attractive, and valuable as any book dealing with biological theory published since Darwin died.

FLORA OF FRANCE.

FLORE DE FRANCE, contenant la description de toutes les espèces indigènes disposées en tableaux analytiques et illustrée de 2,165 figures représentant les types caractéristiques des genres et des sous-genres. By A. Acloque. 8vo. 1 vol. of 816 pages. Paris: J. B. Ballière et Fils, 1894. Price f.12·50.

IN a laudatory preface, which takes the form of a letter to the publishers, M. Ed. Bureau, professor of botany at the Natural History Museum in Paris, expresses his surprise that anyone should have been found sufficiently bold to undertake a work so considerable as that which M. Acloque has just accomplished. Youth only, he says, could have been capable of so daring an act, but *audaces fortuna juvat*, and fortune has not failed the author in the present case, for M. Bureau finds that the book answers the only sure test which can be applied to one of its kind, namely, to enable the student to run down to their specific names several plants taken at hazard. The object of the work is to assist the field botanist to determine his plants by the aid of dichotomous keys after the manner, for instance, of Hayward's botanists' pocket book, though M. Acloque's bulky volume would make about four of these as regards size. Besides the key the distinctive characters of the families are also given, arranged in sytematic order. In the analytic table of the families the student has the assistance of numerous figures which the author reminds us must be considered as diagrammatic. They will doubtless be useful, though some of them are so extremely rough that they were better left out altogether. For instance, the first four, which are to illustrate vascular and three forms of cellular tissue, will be more of a hindrance than a help to one who is ignorant, while he who knows will scoff at them. The diagrams, however, generally answer well enough to indicate the form of organs or their appearance in section. In the elucidation of genera and species numerous figures are given to illustrate the habit of the plant or inflorescence, and sometimes the form of the leaf, flower, or fruit. Some of these are better than others, but as a whole they compare unfavourably with the plates in Bentham's illustrated handbook. The mere fact that there is in France no similar work will ensure the book a welcome; the text, however, is well arranged and will, except in failing light, when it will be found trying to the eyes, prove a great boon to the student of field botany.

The Natural History of Plants.

The Natural History of Plants. By Kerner von Marilaun. Translated by Professor F. W. Oliver, assisted by Misses Busk and Ewart. (Blackie.)

It is but few years since the General Biology, or Natural History, of Plants became a theme for serious investigation. Nowadays the relations between plants and their surroundings form the subject of a critical scrutiny. The older school of workers in this branch of botany were characterised by their imaginative power and credulity with regard to new theories, rather than by the exercise of any searching enquiries into the truth of their hasty hypotheses. Professor Kerner belongs distinctly to the old and romantic school. It were an exaggeration to say that he is more of a poet than of a botanist. For his book is no mere collection of light fancies; indeed, it includes a rich store of interesting facts which, for the most part, can be gleaned elsewhere only in the scattered papers of specialists. Yet the fact remains that this work, though delightfully fresh and supremely suggestive, is utterly unreliable. With an untamed dogmatism born of a hyperæsthetic imagination, Professor Kerner treats aëry conceits as proven truths. Hence many botanists may doubt the wisdom of translating such a work. Be this as it may, it is easy to appreciate the infinite difficulty involved in the labour of adequately editing an English version. Professor Oliver and his associates have evidently decided to let the work stand as it is in the original. So the theory of the centripetal and centrifugal conduction of water down plants, and the semi-fabulous account of *Lathraea squamaria*, are repeated in the translation. Even if warning footnotes be not put in connection with cases of this sort, surely erroneous, misleading, or heterodox statements should not be left unchallenged. Yet on page 64 we find it indicated that the free nitrogen of the air is not available to the plant save through the assistance of electrical discharges. On page 42, of chlorophyll bodies we are told that "they are produced generally in great numbers in special sac-like excavations in its body, but nowhere except where they are necessary . . ." It would have involved little labour to have given footnotes representing the generally accepted modern views on the subject; and the book could have thus been rendered a less dangerous guide.

But it may seem ungrateful to grumble at the translators' decision to leave the work unaltered, when that which they have attempted—the translation—is such a triumphant success. Professor Kerner's charming German idiom is reflected in clear and graphic English. In its form and get up the English version surpasses the original; in fact it is hard to see how the work could in any way have been improved as a translation. Doubtless this eager and persuasive book will do much towards popularising the study of botany in England.

Percy Groom.

Magazine Articles.

Index to the Periodical Literature of the World (covering the year 1893). [Compiled under the superintendence of Miss E. Hetherington.] 4to. Pp. 224. London: *Review of Reviews* Office, 1894. Price 5s.

Mr. Stead's generous effort to give readers a cheap and ready book of reference to the countless articles appearing in ephemeral literature is a marked improvement on its predecessors. Many suggestions as to additions and revisions have been made, and the majority of them have been accepted. The index proper has grown to 150 pages, 40

pages more than in the volume for 1892, and numerous publications, both British and foreign, have been added to the lists over and above those given and indexed last year. The price of the book is absurdly low in comparison to its value, and there can be no doubt that at present at all events its publication is undertaken at a considerable loss. As before, Miss E. Hetherington and her able staff of women assistants are responsible for the compilation of the index, and the result is worthy of the highest praise.

The first 58 pages are devoted to a list of magazines and other periodicals arranged under countries in four columns, giving the title of the book, the editor, publisher, and explanatory remarks. The remaining 150 pages give a minute and detailed index to the subjects contained in the publications listed. To turn to one entry in this index—Birds—we find no less than 55 articles dealing with the subject were published in magazines during 1893. It may be quite true to say that these are of no particular value and might well be left to perish unrecorded; but, on the other hand, we have the inestimable boon of being able to find out if such and such an article has been written without the wearisome task of searching high and low for it. Turning to another subject quite outside our own, we find under Musicians a record of no less than 100 names of which are given particulars of more or less interest.

We cannot of course enforce the purchase of this book, much as we should like to do so, but we hope few readers of NATURAL SCIENCE will refuse to place upon their shelves a volume so valuable to those who wish to keep themselves in touch with general subjects. With an increased list of subscribers, moreover, comes a corresponding increase in usefulness, for a return of the expenditure will allow of the inclusion of periodicals at present omitted solely for reasons of expense.

THE COUNTRY MONTH BY MONTH.

SOMEWHAT late in the day a copy has been sent us of F. A. Knight's "By Moorland and Sea" (Elliot Stock, 5s.); a re-issue of articles that have appeared in various publications. Mr. Knight is pre-eminently an out-door naturalist, and his bright and brief little chapters, some of them perfect prose poems, are redolent of the fresh air, and are a delightful change after wading through some particularly dry piece of laboratory investigation. Gossipy writings of this class do not, as a rule, come within our province at all; but one chapter, "The Birds'-Nester," is a genuine piece of field natural history, and reveals the true naturalist. It is evident in every line that the writer is a careful observer in close touch with Nature, who feels to the full the truth (as he expresses it), "Happy the man in whose life some room is found to watch the happier children of the air." Some of the process illustrations, too, are strikingly good.

ANOTHER work of the same class is now being issued in monthly parts by Bliss, Sands & Foster, under the title of "The Country Month by Month." It is written not for regular collectors or professed naturalists, but for the crowd of intelligent "general readers" who are now tempted into the country by cheap excursion trains or the cycle. We have received the parts for April and May. Each consists of a short essay on the month, followed by chapters on the plants and animals that may be seen in it. The essay is composed in the main of a series of quotations from poets, good, bad, and

indifferent; the chapters on the plants give a pleasantly worded account of the most interesting flowers that are likely to attract attention. A note on "Wild Life: Furred and Feathered" introduces us to the birds and beasts. An appendix gives a list of the species referred to, with their scientific names. The natural history is written in the sketchy style of Richard Jefferies and the "Son of the Marshes," the latter of whom is the senior editor. Prof. Boulger is responsible for the botanical section of the work. The parts are issued in paper or cloth at one or two shillings respectively. We recommend them heartily to those who are fond of country rambles and wish for help in knowing where, when, and how to look for our most interesting plants and animals. We fear, however, the unsophisticated townsman is not likely to see everything mentioned unless he is ready to rise a good deal earlier than most men do taking holiday in the country.

New Serials.

We have to welcome a new scientific publication from Portugal, the *Annaes de Sciencias Naturaes*, published by Augusto Nobre (8vo. Porto, no. 1, Jan., no. 2, April, 1894). Number one contains, among other matter, a list of plants of the Porto district, by Edwin Johnson; observations on the nervous system of *Arion lusitanicus*, by Augusto Nobre; the birds of Portugal, by W. C. Tait; notes on a large specimen of *Orthagoriscus mola* (the moon-fish), by A. Girard; and numerous notes on matters of local general interest, of which may be mentioned Pisciculture in Portugal, *Narcissus cyclamineus*, and the zoological station of Cascaes. The number is illustrated by three excellent photographic plates from the living plants, showing *Oxalis purpurea*, *Senecio scandens*, and *Narcissus cyclamineus*; and by a plate of the nervous system of the *Arion*, described by Senhor Nobre.

Number two contains papers by Dr. Lopes Vieira on the fresh-water fishes of Portugal, and upon the habits of *Petromyzon*; continuations of Johnson's, Nobre's, and Tait's papers referred to above, and a note on the molluscan fauna of the islands of St. Thomas and Madeira, with a plate. Illustrations of *Petromyzon fluviatilis* and *P. marinus* are also given.

We hope that this journal, so creditably got up, will meet with the success it deserves. It is to be issued three times a year, the annual subscription being 1 m. 800 (= 8s.). Though Portuguese is the language of the editors, we are glad to observe that other languages are not excluded, as witness several contributions in French.

Another new serial reaches us, from Trinidad, no. 1 of the *Proceedings of the Victoria Institute of Trinidad*, an institute which was founded as a memorial of the completion of fifty years' reign of the Queen. In the articles of association we do not see any evidence of the religious prejudice which characterises an institution bearing a similar name in this country. Three papers are printed, viz., Guppy on "Edible Molluska of Trinidad"; Hart on "Ventilation"; Nabe on "Butterflies." They are more educational than scientific. The *Proceedings* are published at "The Mirror" Office, Port-of-Spain.

OBITUARY.

GEORGE JOHN ROMANES.

BORN MAY 26, 1848. DIED JUNE, 1894.

PROFESSOR ROMANES was of Scotch extraction, and was born in Canada in 1848. He was not a public schoolman, but was educated at a succession of private schools, and by tutors in London and abroad. He had a distinguished career at Cambridge, and being possessed of private means, was able to devote himself to research after his University career. This he did with so great success that in 1873 he was Burney Prize Essayist, in 1875 Croonian Lecturer to the Royal Society, and in 1879 he attained to the fellowship of the Royal Society. He was well known as a lecturer at the Royal Institution, at Oxford, and at Edinburgh, but most people came to know his name by his abundant contributions to periodical literature. His many personal friends speak in the warmest manner of his personal qualities, and everyone interested in biology regrets his premature death. We do not profess to write with any great private knowledge of him; but we would call attention to the handsome tribute paid to his memory in the columns of *Nature* by Professor Lankester, who was at once his friend and his controversial opponent.

Professor Romanes was a fertile and ingenious exponent of the Darwinian theory, a critical and profound reasoner on biological philosophy, and a brilliant investigator. His exposition of the orthodox Darwinian theory, published under the title of "The Scientific Evidences of Organic Evolution" in Macmillan's Nature Series, is by far the most lucid, orderly, and simple publication on the subject. The first volume of his "Darwin and after Darwin" (Longmans, Green & Co., 1892) is a more detailed but equally intelligible account of the same subject. In the multitude of books written about or round about Darwinism these two writings of Professor Romanes stand out by their correctness in detail, by their literary merit, and luminous simplicity.

His most notable original investigations were upon the nervous systems of Star-fish and Medusæ. These, for the most part, were contributed to the Royal Society's *Transactions*, but afterwards a popular *resumé* of them was published as the volume on Jelly-fish, Star-fish, and Sea-urchins in the International Scientific Series. The minutiæ of structure and histology did not attract his attention so much as

the study of function; and he investigated the anatomy of these organisms much less than their physiology. Although his work on them was not sufficiently minute or accurate to rank him among morphological specialists, it led him to the equally important study of mental phenomena in animals. Darwin left to him many unpublished notes on Animal Psychology, and upon these, as well as upon his own investigations, were founded the volume upon "Mental Evolution in Animals," and a later volume on the "Origin of Human Faculty." These books have been the occasion of much controversy, but unquestionably they are greater contributions to Comparative Psychology, and hence to the study of the mind of man, than most psychologists were ready to admit. We prophesy that, as now Psychology has abandoned its concubinage with Metaphysic for a fertile union with Physiology, Professor Romanes's work will receive a place more important than that presently assigned to it.

GEORGE JOHN ROMANES.

His contributions to Biological Theory are perhaps the least important part of his works. His theory of physiological segregation was ingenious, but it was based on far too little observation to bear the superstructure he raised on it. In his controversies in various periodicals, he was more apt at arguing over verbal points, and laying stress on "logical inconsistencies," than at appreciating the facts which gave origin to the theories in question. We have had occasion in NATURAL SCIENCE to point out in several instances what we thought defects in his arguments. But it is just and pleasant to add that he was very ready to modify his own views or his conception of the views of others when the stress of facts lay against him, and that this logical acumen served often to expose concealed weaknesses in the arguments of others.

In later years Professor Romanes was conducting a variety of

experiments on an extensive scale, that, had they not been stopped by his untimely death, would have been of great importance in settling many obscure questions of inheritance. Certainly English science is the poorer for the death of this worker, who gave so much time, talent, and ability to the investigation of its more abstruse problems.

We are indebted to the courtesy of the Editor of the *Illustrated London News* for the portrait here given.

DR. AUGUST VON KLIPSTEIN, whose death, on the 16th of April in this year, we recorded in our last number, was the son of the mineralogist, Philipp Engel von Klipstein, of Darmstadt, and was born on June 7, 1801, at Hohen-Solms, near Giessen. In 1836 he was appointed Professor of Mineralogy at Giessen. He is perhaps best known by his monograph on the geology and palæontology of the Eastern Alps, but has also made valuable communications on the geology of the Kupferschiefergebirge, the Odenwald, the Dukedom of Hesse, Upper Suabia, and the Vogelsgebirge. In 1837 he described, with J. J. Kaup, the *Dinotherium giganteum* from Darmstadt.

DR. JOZSEF SZABÓ DE ST. MIKLÓS, who, as already announced, died at Budapest on April 10, at the age of 73, was well-known for his studies in mineralogy, of which science he held the chair in the University of Budapest. He was also President of the Hungarian Geological Society, and secretary to the Natural Science section of the Hungarian Academy. Dr. Szabó was an enthusiastic collector, and the University Museum owes much to his energy and exertions.

DR. K. A. FIEDLER, Privatdocent at the University of Zürich, died on April 2, at the early age of 31. Dr. Fiedler had published, among other things, some interesting experiments on the development of Echinoderm eggs similar to the experiments of Driesch, Herbst, and others.

WE have also to record the deaths of the algologist, ALPHONSE DERBÈS, Honorary Professor at the Faculty of Science at Marseilles; of DR. THOMAS MORONG, Curator of Columbia College, who died on Thursday, April 26. Dr. Morong was especially known for his work on Potamogetons and other allied water plants; he also collected somewhat extensively in Paraguay. And of KNUT FREDRIK THEDENIUS, at Stockholm, on March 4, aged 80. An apothecary and a teacher of Natural History in the Stockholm Gymnasium, Thedenius was the author of several works on Swedish local floras, and also, in conjunction with N. J. Andersson, of a "Svensk Skol-Botanik," containing 250 coloured plates and descriptions of Swedish plants.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

IMPORTANT changes have recently been made in high scientific posts of the United States Government. Major Powell, who for thirteen years has been head of the Geological Survey, has resigned on account of ill-health, due to enlargement of the nerves in his wounded arm. Major Powell is an ardent explorer and ethnologist, and it has been largely through his efforts that there is now so complete an understanding of the Californian Gold Belt and the Rocky Mountain region. Major Powell will not, however, retire into private life, but will become superintendent of the Ethnological Bureau, which was recently severed from the Geological Survey. His successor, as head of the Survey, is Mr. Charles Doolittle Walcott, whose nomination will be heartily welcomed in this country by all who appreciate his thorough and painstaking investigations in the palæontology and stratigraphy of the older rocks of America. There has of late years been some exception taken in certain quarters to the lines on which the work of the Survey has proceeded, but we understand that the present change has nothing whatever to do with these attacks, and that the labours initiated by Major Powell, especially the great topographical map of the United States, will be continued without alteration.

Professor C. V. Riley, for twenty years chief entomologist of the Department of Agriculture, has resigned his post in order to devote himself to scientific work unfettered by the restrictions that necessarily surround a Government servant. His retirement will be regretted by both practical and scientific men, whom the work done in his bureau has so greatly benefited. He is succeeded, at his own recommendation, by Mr. Leland O. Howard, who has been first assistant in the bureau for fourteen years, co-editor of the *Bulletin* with Professor Riley, and is now President of the International Association of Economic Entomologists.

Professor Milton Whitney has been placed in charge of a newly created Division of Agricultural Soils, in the United States Department of Agriculture, which Division is intended to study the relation of soils to crops and the physics of soils.

Lastly, Professor W. H. Holmes has severed his connection with the Bureau of Ethnology to accept the position of head of the department of anthropology in the Columbian Museum at Chicago.

AMONG recent European appointments we note those of Dr. S. J. Hickson to the Professorship of Zoology in the Owens College, Manchester; Professor E. Kalkowsky of Jena to the chair of Geology in the Dresden Technical School, and not Dr. Credner as previously announced; Dr. L. Will to the Professorship of Zoology in the University of Rostock; and Forstassessor G. Sarauw to be assistant in the National Museum, Copenhagen. Professor R. Semon has resigned his position as assistant at the Anatomical Institute of Jena, and Doctors Braus and Drüner have been appointed in his place. We take this opportunity of congratulating Dr. Pfitzer, the Professor of Botany at Heidelberg, on his appointment to the dignity of Geheim-Hofrath, and the University of Oxford on the fact that Francis Galton is now one of its Doctors.

THE following awards have recently been made:—The silver medal of the Zoological Society of London to Mr. H. H. Johnston, C.B., in acknowledgment of

the efforts he has made to increase our knowledge of the zoology of British Central Africa; the gold medal of the Linnean Society of London to Professor E. Haeckel, who was unable to be present to receive the honour on account of recent illness; the Demazières prize of 1,000 francs, in the award of the Paris Academy of Sciences, to the botanist, M. Sauvageau, while the Montagne prize, of the same value, was divided between two other botanists, MM. Cardot and Gaillard.

AT the Ladies' night of the Royal Society, on June 13, Professor McKenny Hughes had an exceedingly interesting exhibit of ancient horns, illustrating the evolution of the breeds of English oxen. In the Palæolithic age there were three species—*Bison priscus*, *Bos primigenius*, and *B. longifrons*. Only the latter survived till the arrival of the Romans, by whom it was crossed with a larger imported breed, having straighter and more upturned horns—a type which is still seen in the tawny Highland cattle and in the Chillingham cattle. All these are whole-coloured; the parti-coloured cattle are a much later introduction. After the withdrawal of the legionaries, stock soon ceased to be selected, and the cattle reverted to the type of *Bos longifrons*.

The Marine Biological Association had added to their exhibit a sole from the North Sea, in which the eye had not shifted from the left to the right side of the body, so that the head remained undistorted. A similar case was quoted last year in a French scientific journal, but the occurrence is a rare one.

Mr. Hutchinson, whose last book we notice in this number, had some small papier maché models of *Megatherium*, *Dinoceras*, and *Plesiosaurus*, which would have pleased us better had some texture been imparted to their surface. Calvity is the prerogative of the most highly-developed among us.

Professor Stewart, with the aid of three specimens of the common shore-crab, taught us how to walk sideways, and showed what modification of locomotory appendages takes place in the hermit crab.

Miss Edna Walter, B.Sc., is, if we mistake not, the first lady that has exhibited at the Royal, and we must congratulate her not only on her exhibit, but on the very lucid explanation she gave of it. It was a goniometer, devised by herself and Mr. H. B. Bourne, for the purpose of projecting a crystal on a sphere, and its value is rather to demonstrate the fundamental axioms of crystallography than to assist in the practical measurement of crystals. Miss Walter has, we understand, further added to the triumphs of her sex by exhibiting this same apparatus at the last meeting of the Mineralogical Society and lecturing upon it *in propria persona*.

THE conversazione given by the Oxford University Junior Scientific Club on May 22 was, in spite of the weather, one of the most successful that we remember, and was attended by over 800 guests. The exhibit that attracted most attention was a block of solid carbon dioxide, weighing 40 lb. This had been sent from the brewery of Messrs. Guinness, in Dublin, packed in a barrel with wool, and had only lost 10 lb. on the journey. The temperature of the solid substance is $-76°$ C., and by its means mercury was solidified and shown to be malleable, while ether was rolled into candles and burnt. Among exhibits of more direct interest to ourselves were a collection showing the adaptation of plants to environment, particularly that of deserts, and experiments showing the distribution of seeds, movement of tendrils, and formation of starch; living marine animals, amœbæ, rotifers, and the like; interesting histological preparations from the human subject; while, despite the Anti-vivisection Society, several physiological experiments were performed on not unwilling visitors, many even shedding their blood in the cause of science. During the evening Captain Lugard gave a very interesting account of East Africa, which evoked the political enthusiasm of the audience.

At a recent meeting of this Society, Mr. A. Vassall read a paper on the Recapitulation Theory, in which he alluded to Dr. Hurst's paper published in our pages. It is, we take the liberty of telling Mr. Vassall, by no means fair to say that "Hurst's opposition simply consists of a direct negative."

In the final school of Animal Morphology at Oxford, Miss Lilian J. Gould, of

Somerville Hall, and Mr. M. D. Hill, of New College, have been placed in the First Class. In the current number of the *Quarterly Journal of Microscopical Science*, there is a paper by Miss Gould on the structure of the fresh-water Rhizopod, *Pelomyxa palustris*, to which Mr. Hill contributes a note. Both have also contributed to our own pages.

THE Conchological Society of Great Britain and Ireland held its annual meeting in Manchester, on June 9, when the President, Mr. W. E. Hoyle, delivered an address on the Classification of the Pelecypoda (Lamellibranchiata).

ON page 315 of our last volume we announced that Miss Brocklehurst had offered some £2,000 to erect a Museum in Macclesfield Public Park. Plans had been prepared for her by a well known architect, embodying the advice of museum experts. Unfortunately, these plans did not meet with the approval of the local surveyor. But the Town Council have now learnt that it is unwise to look a gift horse in the mouth. Miss Brocklehurst has withdrawn her offer.

THE University College of North Wales, Bangor, will, in October, open a Day Training College for the instruction of sixty students equally divided between the two sexes.

A SCIENTIFIC exploring expedition will shortly start for the Macdonnell Ranges in Central Australia. The expedition is at the cost of Mr. W. A. Horn, a member of the House of Assembly of South Australia. All the Australian Colonies, however, have been invited to send scientific men, and we learn that Professor Baldwin Spencer, of Melbourne, intends to take this opportunity of studying the fauna of this little-known region.

MR. W. H. SHRUBSOLE, F.G.S., of Sheerness-on-Sea, has been good enough to send us a paper announcing that he is prepared to accept engagements to deliver lectures on the "Curious Dwellers on our Shores," also on "Coal and its Products." It is not our custom to give advertisements for nothing, but, in the intervals of a busy life, Mr. Shrubsole has done so much for Natural Science that NATURAL SCIENCE can hardly refuse so slight a return.

WE learn from the *Botanical Gazette* that the Botanists of the United States are combining for the purpose of making "a compact and complete presentation of the North American flora, so far as it is known." Arrangements have been made for the publication of a "Systematic Botany of North America," under the editorial control of eight well-known botanists, while the co-operation of at least thirty more has already been secured. The work is to appear in seventeen volumes, with about five parts to each volume, and 100 pages to each part. It is hoped that five or six parts will appear annually, beginning with 1895. There will be no illustrations, but full references will be made to published figures. "Special features will be the examination of type-specimens, the citation of type localities, geographical distribution, and a discussion of the economic, palæontologic, and horticultural features of each order." As regards sequence of orders, the editors propose to follow Engler and Prantl in the "Pflanzenfamilien." It is thought that such a work will make information so accessible that study will be stimulated and knowledge extended much more rapidly. Its course of preparation also will doubtless develop many new investigators. The *Gazette* does not state what are to be the geographical limits of the flora, whether, for instance, "North America" includes Canada, which, we notice, is not represented on the editorial board.

A SECOND edition of the concise Guide to the Mitchell Library, Glasgow, has recently been issued. This free public library was provided by Mr. Stephen

Mitchell, a tobacco manufacturer of the city, who died in 1874. It was opened in 1877, in temporary premises in Ingram Street, but since 1890 has occupied the buildings in Miller Street formerly used by the Water Commissioners. Some idea of the size of the Library may be obtained from the fact that no less than 349 magazines and periodicals are placed during currency on the tables in the Magazine Room. Among them Natural Science occupies a prominent position, such journals as the *American Naturalist*, *Annals and Magazine of Natural History*, *Botanical Magazine*, *Entomologist*, *Entomologists' Monthly Magazine*, *Geographical Journal*, *Geological Magazine*, *Quarterly Journal of the Geological Society*, *Journal of the Royal Microscopical Society*, *Mineralogical Magazine*, NATURAL SCIENCE, *Nature*, *Science*, and *Zoologist*, finding a place in the series. One of the excellent rules provided by the representatives of the Founder sets forth that the Library should aim at representing every phase of human thought and every variety of human opinion, and that no book should be refused admission merely because it controverted present views on religion or politics. After all, Glasgow is not so black as she has been painted.

AN International Congress of Applied Chemistry will be held at Brussels, from the 4th to the 11th of August, under the patronage of the Belgian Government. There are four sections, representing (*a*) the sugar industry, (*b*) agricultural chemistry, (*c*) alimentation and public hygiene, (*d*) biological chemistry, dealing chiefly with fermentation. Among the objects to be undertaken by this Congress, we are very glad to note "un ensembles de mesures destinees a faciliter aux specialistes et techniciens l'acces rapide de toutes les publications qui les interessent." Those who wish for further details of the Congress should apply to Mr. F. Sachs, Rue d'Allemagne, 68, Bruxelles.

THE Shah of Persia has instituted a zoological garden mainly for the purpose of introducing the native animals of Europe to his subjects.

THE Vienna Academy of Sciences are preparing an expedition, under the direction of Dr. Steindachner, to explore the deep waters of the Mediterranean.

CORRESPONDENCE.

The Natural History of the Flower.

Mr. J. C. Willis (Natural Science, vol. iv., p. 347), I am glad to see, has arrived at precisely the same result in his experimental study of flowers as I maintained six years ago in my book, "The Origin of Floral Structures," etc., viz., that the phenomena bearing on sex, cleistogamy, etc., "are primarily due to the action upon the plant of external causes." The only point to which I cannot follow him is when he says, "Natural Selection apparently only begins to act later on." I would ask what *facts* are producible to *prove* that Natural Selection acts at all on the maintenance, if not the origin, of any floral and, indeed, other structures? Be it observed that his first conclusion, just stated, is based on positive facts which are accumulative; the second, that Natural Selection plays a part, is an *assumption* for which he supplies none.

Mr. Willis is by no means alone in thus introducing Natural Selection. For example, Mr. Cockerell, in describing the dwarf character of many high Alpine plants, which he attributes to the direct action of the environment, adds: "It appears, however, that Natural Selection may come into play," etc., and gives three hypothetical applications (*Nature*, xliii., 1891, p. 207). It seems to me these and other similar appeals to Natural Selection are simply a sort of unconscious tribute to Mr. Darwin; but since the adaptations as described by these authors are all illustrations of plants varying in *definite* directions in response to the environment, surely it would be a higher tribute to him to quote his own description not only of such an origin of variation, but of its maintenance. For not only does he say that "Natural Selection has no relation whatever to the primary cause of any modification of structure" (*Anim. and Pl. under Dom.*, ii., p. 272); but he observes: "By the term definite action I mean an action of such a nature that when many individuals of the same variety are exposed during several generations to any change in their physical conditions of life, all, or nearly all, the individuals are modified in the same manner. A new subvariety would thus be produced without the aid of Natural Selection." (*Anim. and Pl.*, etc., ii., p. 271).

Mr. Darwin, arguing from cultivated plants—in which *indefinite* variation is the rule, so that artificial selection is absolutely necessary—*imagined* indefinite variation to be also the rule in Nature, and *definite* variation to be the exception. Such is, however, not the case. Variation in Nature is always, as Mr. Willis, Mr. Cockerell, and many other writers have of late years maintained, in strict adaptation to the direct action of the environment; in other words, *natural variation is always definite*. Hence Mr. Darwin himself proves, though contrary to the title of his book, that the origin and maintenance of specific characters are without the aid of Natural Selection.

George Henslow.

Sir,—From the fact that our flora resembles the flora of northern Europe in being visited by a larger proportion of flies than has been observed in the neighbouring regions of the Continent, Mr. J. C. Willis infers that "our flora would seem rather more closely allied to these northern floras in this respect than to the nearer Continental flora" (Natural Science, iv., p. 349). Before this inference can be accepted it will be necessary to prove that this resemblance is not merely the result of similar circumstances, such as the natural preponderance of flies over other insects in our own and northern countries.

It may also be pointed out that Mr. Willis's general conclusion, at the bottom of p. 350, implies the inheritance of acquired characters. External causes, he says, produce various degrees of sexual development, on which "Natural Selection only begins to act later on." But Natural Selection, we are told, can only act on characters that are congenital. Does Mr. Willis appreciate the importance of his own conclusion, and what has he to say to this interpretation of it?

ENTOMOPHILOS.

THE HATCHING OF THE OCTOPUS.

MISS AGNES CRANE writes expressing astonishment at the ignorance displayed in our notes on the octopus in last month's "Notes and Comments." She says:—

"As a matter of fact the 'brooding' of the 'hen' octopus and the hatching of the eggs was a fifty days' wonder at the Brighton Aquarium many years ago, and the subject of general comment in the daily and weekly Press. I have watched the female often hovering over the two dozen or more live oysters she had sedulously accumulated in a rocky crevice of her tank near the glass for weeks together. Full descriptions appeared in the *Times*, *Land and Water*, *The Field*, etc., at the time, and Mr. Henry Lee subsequently devoted a whole chapter to 'The Spawning of the Octopus,' recording his observations in his 'Aquarium Notes' on 'The Octopus of Fiction and the Octopus of Fact,' published by Chapman and Hall in 1875.

"Therein he relates that the female octopus deposits her eggs, 'which look like little grains of rice,' in strings, at intervals, for three days, a fair-sized specimen producing ten or twelve long strings, or clusters, or a possible progeny of from forty to fifty thousand individuals, that she broods over them, guards them, and cleanses them, taking but *little food* the while, and becoming quite exhausted by her maternal cares.

"Moreover, your contributor used the word 'incubation' loosely, and seemed to imply that the octopus sits upon its eggs for the purpose of hatching them by the heat of her body. Mr. Lee held this theory not proven, as he succeeded in hatching out a brood of several hundred young octopods from ova which had been removed from the mother in question and placed in a tank by themselves.

"Young octopods are described 'as almost as big as a flea, and, when irritated, of much the same colour,' and as able to assimilate their hue to the colour of their surroundings even before they have left the envelope. The brood referred to lived about three weeks, but ultimately succumbed, possibly to the over-assiduous attentions of their scientific dry nurses: at that time Mr. Frank Buckland, Mr. Henry Lee, and Mr. W. Saville Kent were all professionally attached to the Institution. The eggs of the Sepia and of *Loligo* were also hatched out independently at the Aquarium when removed from parental care. The octopus, therefore, probably guards, cares for, and hatches her eggs just as the nest-building 'fifteen-spined' sticklebacks do, and not in the usual sense of the word incubation. Mr. Lee stated 'that octopods he had known' differed much in their manner of 'brooding' over their eggs. He also recorded the occurrence of a full-grown female octopus and her eggs within an earthen two-gallon carboy which had been dredged in the channel, and of which the neck measured only two inches in diameter. But I have said more than enough to prove that the 'hatching of the octopus' has not been forgotten since the days of Aristotle.

[We protest against the assumption that "incubation" involves heat. The term actually was applied to fish by Owen.—ED.]

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